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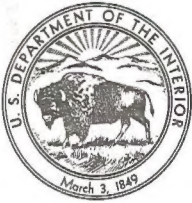


88009487



DRAFT ENVIRONMENTAL STATEMENT

FEDERAL COAL MANAGEMENT PROGRAM



IN REPLY REFER TO:

United States Department of the Interior

1792 (142)

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

Enclosed for your review and comment is the draft environmental statement (DES) for the Federal coal management program.

This programmatic statement is based on information developed by the Bureau of Land Management and the Department of the Interior. Information and data were supplied by and in coordination and consultation with Federal, State and local governmental departments and agencies, and a number of organizations and individuals. The purpose of the statement is to address various alternatives for a Federal coal management program, including a preferred program alternative, and to assess the possible impacts from the various alternatives. The statement is programmatic in scope and discusses the national and interregional impacts associated with the Federal coal management program. Impacts assessment includes coverage of 12 coal supply regions, 3 production levels (low, medium and high), 7 alternative management strategies, 2 projection periods (1985 and 1990), 5 phases of the coal production and use cycle, and 27 impact categories. The statement also includes a set of example regulations which could be used to implement most of the alternative management programs.

We would appreciate receiving any review comments you may wish to make as soon as possible. The comment period extends to February 13, 1979. A series of public meetings and formal hearings on the statement are scheduled to be held during January and early February 1979, throughout the United States and in the major coal producing regions in the West. Information on these meetings will be announced in local, regional and national news media.

Please send all comments to:

Office of Coal Management (140)
Bureau of Land Management
18th and C Streets, N.W.,
Washington, D. C. 20240

Comments may also be delivered to the Office of Coal Management, Room 3610,
Main Interior Building, 18th and C Streets, N.W., Washington, D.C. 20240.

Sincerely,


Director

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UNITED STATES
DEPARTMENT OF THE INTERIOR
DRAFT ENVIRONMENTAL STATEMENT

FEDERAL COAL
MANAGEMENT
PROGRAM

DECEMBER 1978

PREPARED BY THE
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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ACKNOWLEDGEMENTS

Assistance to the Bureau of Land Management, U.S. Department of the Interior in the preparation of portions of this Draft Environmental Statement was provided by the MITRE Corporation, McLean, Virginia. Guidance in the preparation of this statement was provided by the Office of Coal Management, Bureau of Land Management and the Office of Coal Leasing, Policy and Coordination, U.S. Department of the Interior.

SUMMARY

Draft (X)

Final ()

Environmental Statement

1. Type of Action: Administrative (X) Legislative ()

2. Brief Description of Action: This draft programmatic environmental statement considers the environmental impacts of seven alternatives for a Federal coal management program to be adopted by the Department of the Interior. The proposed action is the adoption of the preferred Federal coal management program. The program would establish standards and procedures for determining when, where, and in what manner coal owned by the United States Government should, through competitive lease sales, be sold to parties who will cause the coal to be mined. As a part of the program, before competitive lease sales would be held, the Secretary of the Interior would determine whether there is a need for such sales in order to make Federally-owned coal available for production. Determination of the need for leasing will be based on analyses of expected coal production in relation to projected demand for coal.

Identification of Federal coal that can be considered for leasing would be done through the land use planning process of the Bureau of Land Management, Department of the Interior, under the Federal Land Policy and Management Act of 1976 and the Federal Coal Leasing Amendments Act of 1976, and the Forest Service, Department of Agriculture, under the Multiple-Use Sustained-Yield Act of 1960 and the National Forest Management Act of 1976. Selection of specific tracts of coal to be offered for lease and the administration of the lease sales would be conducted by the Bureau of Land Management. Specific standards would be used to identify lands where mining Federal coal would cause unacceptable damage to lands or resources. Tracts in those areas not found unsuitable for mining would be further evaluated and the value of potential coal development considered in comparison to other values, such as wildlife management, recreation, watershed protection, or stock grazing, which might be foreclosed or diminished if the coal were to be developed. All tracts selected in each of eight Federal coal production regions for possible leasing would be ranked region-wide on the basis of coal quantity and quality, cost of extraction, and social, economic, and environmental impacts of mining. Priority in selecting tracts to be offered for lease sales in each region would be assigned to those tracts which could be most productively developed with the least social, economic, and environmental damage.

A central feature of the preferred Federal coal management program would be emphasis on participation by the public and by state and local governments in all aspects of the program. Information, advice, and opinion would be sought from all parties interested in decisions about Federal coal management. Assessment of the need for leasing, establishment of coal production goals, application of standards for determining lands unsuitable for leasing, planning to decide which of those areas that could be leased should be leased rather than be put to other uses, and ranking and selection of tracts to be offered for lease sale will be conducted in an open, accountable way, in a process designed to make decisions as responsive as possible to suggestions from those interests most affected by the decisions. Consideration of social and economic consequences as evaluated by state governments will be given special weight when decisions about Federal coal management are made.

3. Summary of Environmental Impacts: This is a programmatic environmental statement. The Federal coal management program will be established in June, 1979. As a result of the operation of the program, decisions could be made that would result in competitive coal lease sales in some areas, deferral of decisions about whether leasing should take place in other areas, and the elimination of still other areas from further consideration as potential sites for leasing and mining of Federal coal.

The environmental impacts which are expected to result from implementation of the Federal coal management program will vary within regions and over time. In the short term, many regions will experience substantial increases in coal production for several years, with or without additional leasing. Demand for coal in those regions will lead producers to develop available reserves. Leasing under such circumstances would not add significantly to cumulative social, economic, and environmental impacts within the region, but could cause intra-regional shifts in specific production sites if producers responded to more attractive development opportunities created by the availability of new Federal leases. A decision not to lease in the next several years could also diminish or foreclose production opportunities in an area, causing producers to turn their attention to other reserves, within or outside of a given area, which could be developed without Federal leasing. Whether the environmental consequences of production shifts caused by a Federal coal management program, and the decision which would be made under the program to lease or not to lease in the next several years, would be generally more or less damaging to the environment could only be determined through analysis of specific management decisions. As described in this statement, such specific management decisions would be made only after land use planning and environmental analyses designed to minimize environmental damage have been conducted.

Over time, production from additional Federal leasing could account for a larger share of total production, and so would be responsible for a larger percentage of the environmental consequences of production.

Decisions not to lease could severely limit the production of coal in the western United States. The social, economic, and environmental consequences of program decisions under such circumstances would depend on the type and location of energy sources that would be used as alternatives to coal from the western United States.

In this statement, the environmental consequences of a Federal coal management program are described on a national and inter-regional basis. While many impacts, both beneficial and damaging, can be directly attributed to coal production that would result from decisions made under such a program, a wide range of impacts would result from decisions about the transportation, conversion, and use of coal. Furthermore, certain intra-regional impacts are too-site specific, or require management decisions not yet made which are too detailed or incapable of discernment, to be considered in a programmatic environmental impact statement. The unavoidable national and inter-regional impacts of coal production that could result from decisions made under the program include:

- Subsidence of land could result from underground mining activities.
- Existing vegetation would be destroyed on sites cleared for development and surface mining, and wildlife habitat would be lost or temporarily displaced.
- Present agricultural use in some areas would be converted to residential, commercial or industrial uses.
- Industrial and municipal demand for water would increase; generally, water would be available for these uses but in some western states the new demands may compete with present water uses, and the competition will cause price increases that may cause economic problems for agricultural water users.
- Water quality may be lowered and total dissolved and suspended solids would increase due to industrial return flows and construction activities.
- Aquifers may be disrupted and their long-term productivity could be reduced.
- Increases in emissions of sulfur oxides, nitrogen oxides, carbon monoxide, carbon dioxide, hydrocarbons, trace elements, and particulates would occur with some degradation of local and regional air quality.
- Topographical features would be altered by construction and mining activities.
- There could be some loss of archaeological and historical sites.
- Some fossils would be destroyed, others would be revealed.
- The present visual quality of the landscape would be changed as a result of new coal mining and cleaning facilities, transportation networks, coal conversion plants, transmission lines, and urban expansion. Population would increase in some areas.
- Educational, police and fire protection, sewage and water, recreational, and other public facilities and services would not keep pace with population increases in some regions, straining personnel and budget levels of local and state governments.
- Communities could lose their small town atmosphere and residents of rural areas would experience a change in their traditional life-styles.
- Transportation arteries, including rail lines, would experience heavier average daily traffic with significant impact at rail grade crossings.
- Employment increases would occur from coal development, and increased construction wages and investment in the impacted regions would lead to higher personal income, retail sales, and property values. This could also result in tight housing markets and inflation adversely affecting those persons on fixed incomes.
- Fatal accidents and disabling injuries would undoubtedly occur as a result of coal development activities.

4. Alternatives Considered: Considered in this environmental impact statement are seven alternatives: the preferred program, no new Federal leasing, preference right lease applications (PRLAs) only, short-term leasing only, meet industry indications of needs, meet the United States Department of Energy production goals, and state determination of leasing levels. Numerous policy alternatives are capable of incorporation in various of the alternatives. Twelve coal regions are specified: Northern Appalachian Coal Region (Pennsylvania, Ohio, Maryland, West Virginia); Central Appalachian Coal Region (Virginia, Kentucky); Southern Appalachian Coal Region (Tennessee, Alabama); Eastern Interior Coal Region (Illinois, Indiana, Kentucky), Western Interior Coal Region (Iowa, Kansas, Missouri, Nebraska, Arkansas, Oklahoma); Texas Coal Region (Texas, Louisiana); Denver-Raton Mesa Coal Region (Colorado, New Mexico); San Juan River Coal Region (Colorado, New Mexico); Uinta-Southwestern Utah Coal Region (Colorado, Utah); Green-River-Hams Fork Coal Region (Colorado, Utah, Wyoming); Powder River Coal Region (Montana, Wyoming); and Fort Union Coal Region (Montana, North Dakota).

5. Comments on the draft environmental statement: Comments have been requested from various individuals, organizations and governmental agencies indicated in Table 8-1, state clearing-house agencies in the fifty states, and the Federal agencies listed in Table 8-3 of this statement.

6. Date Draft Statement was made available to the Environmental Protection Agency and the Public: December 15, 1978.

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- 3 DESCRIPTION OF THE PREFERRED COAL MANAGEMENT PROGRAM AND ALTERNATIVES
- 4 DESCRIPTION OF REGIONAL ENVIRONMENTS
- 5 REGIONAL IMPACTS OF FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES
- 6 MITIGATION OF MAJOR ADVERSE IMPACTS OF A FEDERAL COAL MANAGEMENT PROGRAM
- 7 LONG-TERM ENVIRONMENTAL CONSEQUENCES OF THE FEDERAL COAL MANAGEMENT PROGRAM
- 8 CONSULTATION AND COORDINATION

CHAPTER 1

INTRODUCTION AND BACKGROUND OF COAL MANAGEMENT PROGRAM AND ENVIRONMENTAL IMPACT STATEMENT

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CHAPTER 1

INTRODUCTION AND BACKGROUND OF COAL MANAGEMENT PROGRAM AND ENVIRONMENTAL IMPACT STATEMENT

1.1 INTRODUCTION

This environmental impact statement comes at a critical juncture in a long history of starts and stops for a Federal coal management program administered by the Department of the Interior. The purpose of this impact statement is to meet the Department's responsibilities under the National Environmental Policy Act of 1969 (NEPA), 83 Stat. 852, and to help the Department address four major questions: (1) Should a new Federal coal management program be adopted by the Department of the Interior; (2) What should be included in the program; (3) Is Federal coal leasing necessary to meet the Nation's future energy needs; and (4) What environmental impacts might result from the adoption of a new Federal coal management program and alternatives to such a program?

Why these questions need resolution at this time can be placed in a proper perspective through a brief review of the history of Federal coal policies and activities. From the beginning of Federal land ownership, a policy of disposal of public domain lands was followed. In the century and a half during which this policy held sway, 1.1 billion acres, or more than half of the public domain, was sold or granted to states and private owners. Until the early 1900's, the policy of disposal of Federal lands included the practice of transferring coal and other mineral resources to private owners. However, with the passage of various mineral reservation statutes and the Mineral Leasing Act of 1920, 41 Stat. 438, it became Federal policy to retain and lease rather than to sell Federally-owned coal. Under a leasing system, only the leased mineral, and not the land itself or other associated resources, becomes the property of the lessee. Even that property right is conditioned on lessee compliance with stipulations to protect the mined land, and requirements that the mineral be diligently developed. Particularly between 1955 and 1970, large amounts of Federal coal were leased under the Mineral Leasing Act with little regard to the need for leasing, the amount of reserves contained within leases or when (or if) the leases would be developed. There was no enforcement of the Mineral Leasing Act's requirement that leases be diligently developed.

A Bureau of Land Management (BLM) study [1] issued in 1970 reported that, while the amount of Federal coal under lease was rapidly increasing, production was declining. As a result of that study, the Department of the Interior, in May 1971, imposed an informal leasing moratorium in order to reassess its leasing policy. In February 1973, the Secretary of the Interior imposed a formal leasing moratorium and announced his intention to establish a new coal leasing policy. In the short term, the Department would issue leases only to avoid losing coal where it would be bypassed, to maintain

existing coal operations, or to provide reserves for production needed in the near future.

The newly designed long-term leasing program was presented in the Department of the Interior's May 1974 draft environmental impact statement on its proposed coal leasing program [2]. The heart of the program was the Energy Minerals Allocation Recommendation System (EMARS I), under which the Department of the Interior would specify leasing needs on the basis of estimates of national energy requirements. The final impact statement issued in September 1975 modified the system to the Energy Minerals Activity Recommendation System (EMARS II)[3]. Under the revised program, the Department adopted procedures which made greater use of industry nominations of leasing tracts and placed a much stronger emphasis on market determination of the amounts and location of future Federal coal to be leased.

The new Federal coal leasing program was short-lived. It was altered by statute and halted by litigation. From 1975 on, the development of a Federal coal management program has been significantly influenced by actions of each branch of government. Congress enacted four major statutes with important consequences for Federal coal management. The first, the Federal Coal Leasing Amendments Act of 1976 (FCLAA), 90 Stat. 1088, passed in August 1976 over President Ford's veto, was designed to correct the leasing problems that had been experienced under the Mineral Leasing Act of 1920. The Federal Land Policy and Management Act of 1976 (FLPMA), 90 Stat. 2743, passed in October 1976, provides the Bureau of Land Management with a modern management mandate, including requirements for land use planning before coal leasing or other actions may take place on Federal lands. The third major statute was the Surface Mining Control and Reclamation Act of 1977 (SMCRA), 91 Stat. 445, passed in August 1977. SMCRA, a result of Congressional concern over the adverse environmental effects associated with the significant shift in technology from underground to surface mining methods, requires control over these effects by the Federal and state governments. Finally, the Department of Energy Organization Act (DOE Act), 91 Stat. 565, also passed in August 1977, transferred from the Department of the Interior to the Department of Energy several important coal-related responsibilities, including issuance of regulations governing diligent development and bidding systems.

The Judiciary has provided guidance for the preparation of a new Federal coal management program, particularly in two recent decisions.

The Supreme Court's 1976 decision, *Sierra Club v. Kleppe*, 427 U.S. 390 (1976), provided judicial instruction concerning what kind of environmental reviews must accompany major coal management decisions. Of more direct importance,

INTRODUCTION AND BACKGROUND

however, is the September 1977 decision in *NRDC v. Hughes*, 437 F.Supp. 981 (D.D.C. 1977), amended, 454 F. Supp. 148, appeal pending. The court's order enjoined most Federal coal leasing activity until the Department of the Interior issues supplemental draft and final environmental impact statements on its coal management program. The Department has prepared this statement to comply with the environmental impact requirements of section 102 (2)(C) of NEPA and that court order.

This discussion provides a brief overview of the recent history of Federal coal management activities. The background of Federal leasing, beginning with the Mineral Leasing Act of 1920, is presented in more detail in subsequent sections of this chapter.

1.1.1 Purpose of Draft Environmental Impact Statement

The purpose of this statement is to address the overall national and inter-regional environmental impacts of a proposed Federal coal management program administered by the Department of the Interior and to fully analyze the alternatives to the proposed program.

1.1.2 Summary of Program Alternatives

Seven broad Federal coal management program alternatives, including a preferred program, are analyzed in this statement. Unlike most impact statements prepared by the Department and other Federal agencies, a proposed "action" and its alternatives are not treated in separate chapters. Rather, the statement presents a series of alternatives, one of which is tentatively "preferred" by the Department. Major subalternatives are also described and analyzed. This is consistent with the Secretary of the Interior's desire that the Department critically evaluate its entire coal management process. An integral part of this evaluation is and will continue to be comments from interested parties, including other Federal agencies, state and local governments, private and public organizations, and concerned individuals. Initial comments from these parties have already been obtained (see Chapter 8). Further comment is invited during the public review of this draft environmental impact statement and will be responded to in a final environmental impact statement. These comments, along with continuing evaluation within the Department, may result in modification of the preferred and other alternatives in the final statement. Furthermore, additional public comments will be invited and considered during the program decision-making process which will follow issuance of the final statement.

A brief overview of the program alternatives follows. A more detailed description is contained in Chapter 3.

- **Preferred Alternative.** Decisions to lease Federal coal would be made as an integral part of the Federal land planning process. Federal lands would be considered for leasing which have not been found unsuitable for coal mining or more valuable for resource protection or development activities in the land use planning process of the Federal land management agencies. In the activity planning process, tracts would be delineated, ranked on the basis of coal quality, cost, and environmental, social, and economic effects and

selected for sale. Regional production targets, derived from production goals submitted biennially by the Department of Energy and comments received from consultation with the States, industry, and the public, would be applied during the activity planning process to ensure that sufficient tracts would be ranked and selected to meet national energy needs. The preferred alternative is similar to EMARS I as proposed in the Department's 1974 draft programmatic environmental impact statement on the Federal coal leasing program (see Section 1.2.4) [2] in that both rely on national energy projections to establish how much coal is to be leased. The preferred alternative differs markedly in, among other things, emphasis on land-use planning and consultation with the states than did EMARS I.

- **No new Federal Leasing.** No new Federal coal would be leased until at least 1985, including coal needed for by-pass situations or to maintain existing operations (see section 1.2.6 for description of terms). Preference right lease applications (PRLAs) would be either rejected, not processed, exchanged for other mineral leases, or purchased.
- **Process Outstanding Noncompetitive Coal Lease Applications (PRLAs).** Leasing until at least 1985 would be limited to PRLAs which meet the commercial quantities tests.
- **Emergency Leasing.** There would be limited competitive leasing and issuing of PRLAs to prevent coal from being bypassed and to maintain existing coal mining operations. The need for new competitive leasing would be reviewed in 1985. This option is a continuation of the status quo and would be similar to the type of leasing permitted under *NRDC v. Hughes*. (See section 1.2.6 for a further explanation of this policy.)
- **Satisfy Industry Indications of Need.** This alternative is effectively the Energy Minerals Activity Recommendation System (EMARS II), as proposed in the Department's 1975 final programmatic environmental impact statement on the Federal coal leasing program (see section 1.2.4) [3], and as adopted in regulations published in the *Federal Register* (42 Fed. Reg. 4422, corrected 42 Fed. Reg. 2546 (1977)).
- **State Determination of Leasing Levels.** The states would have the responsibility to determine the timing and extent of new leasing.
- **Lease to meet Department of Energy (DOE) Production Goals.** Under this alternative, no adjustments (as envisioned in the preferred alternative) would be made to the DOE production goals to reflect the Department's diverse statutory responsibilities or the views received from consulting with the States, industry, and the public. Leasing decisions would be required to meet the DOE goals.

In the implementation of any of these alternatives, the Department would assure compliance with all new statutory requirements including those for land use planning, lease terms, and reclamation of mined lands.

INTRODUCTION AND BACKGROUND

1.1.3 Approach to Environmental Impact Statement

This is a programmatic statement which assesses the national impacts of the Federal coal management program and related Federal coal policies. The statement covers all major national aspects of the management program and alternatives, and assesses impacts of alternative programs in twelve specific coal regions (see Figure 1-1). Thus, the issues analysed are quite different from those discussed for a particular lease area. A broad statement of overall impacts of the program will allow the Department to make decisions concerning national and multiregional questions.

The methodology used in this programmatic statement is, therefore, a general predictive approach based on national and regional data and using necessary assumptions where firm data are not available. Reasonable forecasting is implicit in NEPA. With 27 coal states and 12 regions which could be directly affected by coal extraction, and other states indirectly affected by the consumptive use of coal, data used in this statement must be generic and cannot be site specific; however, impacts are quantified, wherever possible, to display the differences between the various alternatives. Nonquantifiable aspects (such as aesthetics, lifestyle changes, and cultural values) are also addressed.

The impact analysis uses two principal models. One is the Department of Energy's National Coal Model, which predicts the high, moderate, and low coal demands for coal regions, in 1985 and 1990, under various demand scenarios and constraints. The second model used is the Department's Coal Impact Estimation Program which relates quantifiable "environmental loadings" to predicted coal production and use levels by region.

This statement addresses the total national demand for coal, and impacts associated with Federal and non-Federal coal development. Consideration of non-Federal coal resources is necessary, first, to place impacts of the Federal coal management program in a broader perspective; and second, because Federal actions have the potential to shift and aggregate production between private and public coal. Presentation of total coal demand establishes a base-line from which environmental analysis may proceed.

The content and format of this statement, as outlined in the table of contents, represents a combination of approaches. It contains a modified standard format as required in the BLM Manual, section 1792, revised to incorporate some of the principles of the Council on Environmental Quality's (CEQ) proposed NEPA rules [4], with emphasis on the requirements of the *NRDC v. Hughes* court order. This chapter provides the background to this statement. Included is a discussion of prior and current coal policy directives and applicable laws and regulations. The importance of coal as an energy resource is discussed in Chapter 2. Chapter 2 also describes the characteristics of coal development activities as well as the relationship of coal to other energy sources. Past and projected coal production levels and the need for additional Federal coal leasing are then addressed.

Chapter 3 presents the issues and options identified during the course of the Department's review of its coal management responsibilities, the Secretary of the Interior's preferences, among the options, the Secretary's preferred coal management program and alternatives to that program.

Chapter 4 provides an overview of the existing environmental conditions in each of the twelve regions.

Chapter 5 assesses the environmental impacts related to the preferred and alternative coal management strategies and concludes with a comparative analysis of all program alternatives. Chapters 6 and 7 contain the summary analyses required by section 102(2)(C)(ii-v) of NEPA. Finally, the coordination activities involved in preparation of this statement are summarized in Chapter 8, including how the Department sought and received comments on this modified format.

1.1.4 Relationship to Ongoing Regional Environmental Statements and Studies

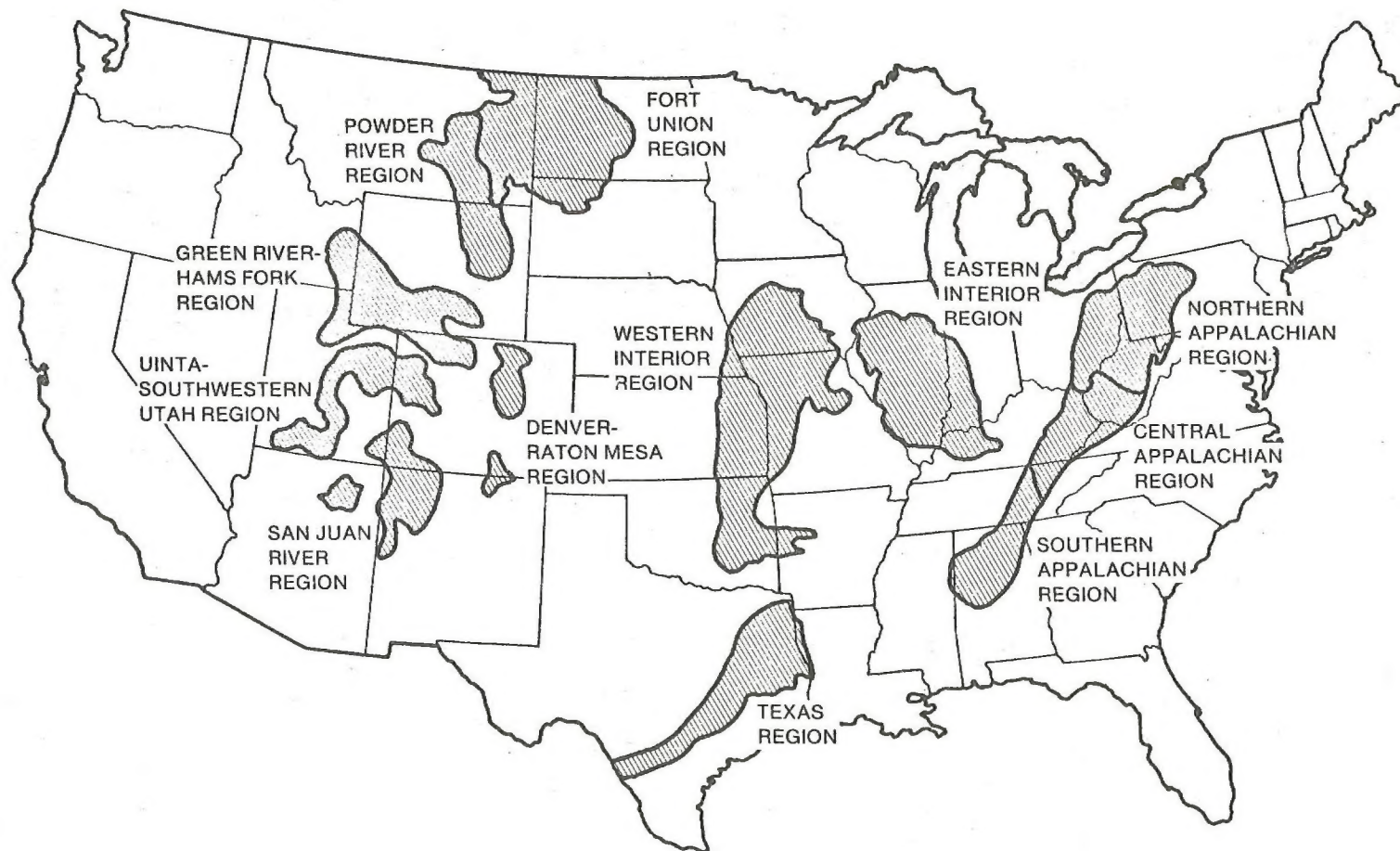
The Department is currently preparing comprehensive coal environmental impact statements on activities occurring in eight geographic areas. Under a policy formally adopted in 1976, these comprehensive analyses are called for whenever the Department is faced with multiple coal-related actions in a broad geographic area. These actions could involve issuing coal leases, approving mining and reclamation plans on existing leases, and right-of-way permit requests for coal-haul roads, railroads, access roads, or transmission lines.

The areas covered by these statements were chosen after consideration of coal basin boundaries, drainage areas, areas of common reclamation characteristics, administrative boundaries, areas of economic interdependence, and other relevant factors. The regional statements include a broad, overview analysis of environmental impacts associated with current and potential coal development activities, as well as site-specific analyses of mine plans, and right-of-way permits for which administrative action is proposed. These statements also address related coal development activities not requiring specific Departmental approval, such as mine-mouth electrical generating or energy conversion facilities, and the expansion of existing or construction of new communities to accommodate coal-induced population increases. The eight areas covered by these statements are depicted in Figure 1-2. These areas are smaller than the twelve regions assessed in this statement. Table 1-1 summarizes pertinent coal development activities analyzed in the ongoing statements.

The Department will complete these ongoing statements; initiation of new statements of this type is contingent on program decisions which may be made after the final version of this statement is published and comments on it are received and considered by the Department.

Additionally, for each individual coal lease and mining plan an environmental analysis is prepared to determine whether a detailed environmental impact statement is required. If associated impacts are significant within the meaning of NEPA, a site-specific statement is prepared, either separately or as part of a regional analysis.

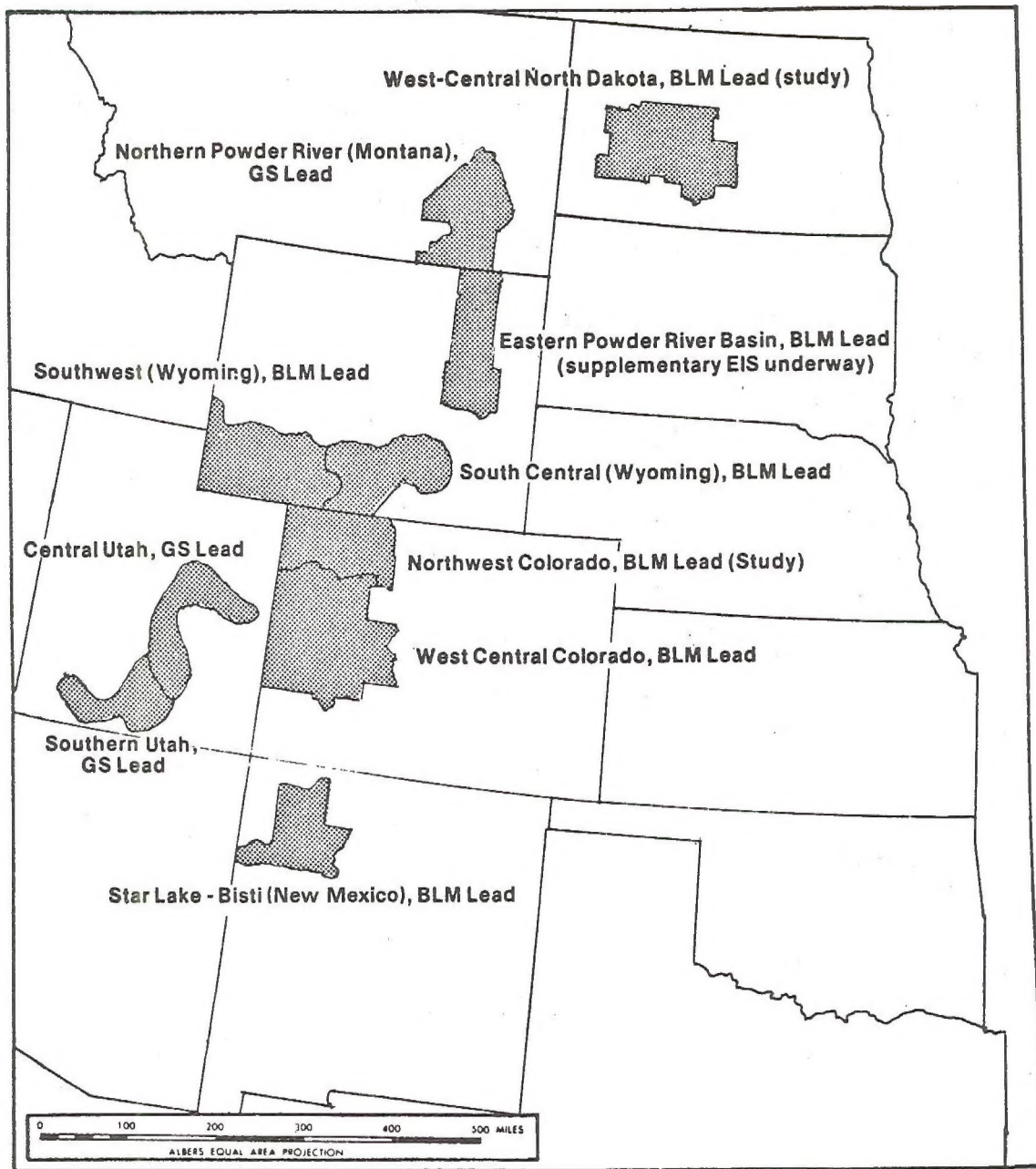
Current Departmental policy for preparing environmental assessments and impact statements thus covers generic (programmatic), regional, and site-specific considerations. Proposals to modify this approach as part of a revised coal management program are discussed in Chapter 3.



NOTE: Shaded areas indicate coal regions described in this statement.

FIGURE 1-1

TWELVE COAL SUPPLY REGIONS OF THE UNITED STATES



NOTE: "BLM Lead" signifies that the Bureau of Land Management has lead agency responsibility for preparing the document.
 "GS Lead" signifies that the U.S. Geological Survey has lead agency responsibility for preparing the document.

FIGURE 1-2
 REGIONAL AREAS COVERED BY
 ENVIRONMENTAL IMPACT STATEMENTS OR STUDIES

TABLE 1-1
SITE-SPECIFIC PROPOSED ACTIONS
IN THE ONGOING REGIONAL ENVIRONMENTAL STATEMENTS

REGIONAL STATEMENT	PROPOSED SITE-SPECIFIC ACTIONS	
	MINING AND RECLAMATION PLANS	RIGHTS- OF WAY APPLICATIONS
Southwest Wyoming	4	13
South Central Wyoming	3	9
Eastern Powder River, Wyoming, Supplement	1	0
Southern Utah	3	0
Central Utah	7	15
West Central Colorado	6	0
Star Lake-Bisti New Mexico	0	2
Northern Powder River, Montana	<u>1</u>	<u>1</u>
TOTAL	25	40

NOTE: Two additional Environmental Planning Studies, the Northwest Colorado Environment Planning Study and the West Central North Dakota Environmental Planning Study, are also underway.

INTRODUCTION AND BACKGROUND

1.1.5 General Purpose of Coal Management Policy

The need for a new look at the Federal coal management program is related to three broad conditions. The first is the Nation's serious energy problem, characterized by declining domestic oil and gas resources and limited alternatives. A national policy goal has been advanced to reduce reliance on imported oil. The National Energy Plan (NEP) [5] announced by President Carter in April 1977 presents detailed steps to be taken to achieve this goal. Salient features of the NEP include energy conservation, rational fuel pricing policies, and increased use of abundant domestic energy sources. Although coal comprises 90 percent of the country's fossil fuel reserve, only 18 percent of the national energy needs are met by coal. A cornerstone of the National Energy Plan is the goal of correcting this imbalance between coal reserves and consumption by doubling 1977 annual production by 1985. Coal from mines under Federal leases has accounted and was expected to continue to account for a significant share in the expanding use of this resource.

The second condition results from the failure of former coal management practices to address current concerns. Major concerns expressed both within and outside of the Department are the Government's historically passive role in coal leasing decisions, lack of active control over production from Federal leases, absence of an effective system to ensure fair market return for the right to mine Federal coal, and the potential for serious social, economic, and ecological impacts of expanded coal production and use.

Finally, as briefly discussed in the introduction to this chapter, a reassessment of the coal management program has been precipitated by recent critical reviews of management practices by the Executive, Judicial, and Legislative branches of the Federal Government.

1.2 HISTORICAL BACKGROUND

The Federal coal management program is concerned with the development of coal resources on public domain lands and acquired lands. The public domain refers to those lands which are subject to the public land laws of the United States. These lands were acquired primarily by cession, treaty, and purchase from other countries. Table 1-2 summarizes acquisitions of the public domain between 1781 and 1867. Acquired lands are purchased by the United States from private owners after the lands became part of the United States.

Almost as fast as public domain was obtained, it was disposed of by the Federal Government to further national goals. These dispositions provided rewards for soldiers and other deserving persons, encouragement for the rapid settlement and development of the western states, incentives for construction of railroads and canals, and many other purposes. Dispositions of public lands included more than 1.1 billion acres between 1781 and 1963 (see Table 1-3).

Early development of Federal coal lands was governed by a law controlling land entry and sale [6]. Under this law a maximum of 160 acres could be granted to an individual; up to 640 acres were allowed to groups of four or more persons who had expended at least \$5,000 in work and improvements, where mines were opened and improved, and when the group was in actual possession. Land payments ranged from \$10 to \$20 per acre, depending upon the distance from a railroad. A

claimant who discovered minerals on public domain land received complete transfer of mineral ownership.

Another factor of some importance is that Congress granted extensive lands to railroads in the West. To settle the West, the building of railroads was essential. But to build a railroad was a costly venture, and railroad companies would not build railroads in what was then virtual wilderness without financial inducement. The grant of land by the government to the company was that inducement.

Typically, Congress granted the railroads the odd-numbered sections on both sides of the proposed railroad right-of-way extending back from the right-of-way some 10 or 20 miles on each side of the railroad. The even-numbered sections, which were not conveyed to the railroad, continued to be in the public domain. By granting to the railroad the odd-numbered sections, and retaining the even-numbered sections, a checkerboard effect resulted. Although Congress probably expected that the granted land would be sold by the railroads to other citizens, much of the acreage has been retained by the original grantees. The resulting checkerboard land patterns and their effect on coal development continue to influence western coal development, particularly in areas of Montana, Wyoming, and New Mexico.

1.2.1 Mineral Leasing Act of 1920

Enactment of the Mineral Leasing Act of 1920 provided a radical policy change for disposal of Federal coal lands. The new policy was to lease coal rather than sell it. Under the law, rights to explore, develop, and remove coal (and other minerals) were acquired through a lease or prospecting permit issued by the Bureau of Land Management.

In areas with no known coal deposits, the Secretary of the Interior could issue prospecting permits which entitled the permittee to the exclusive right to prospect for coal. Each permit had an initial two-year term, but could be extended for an additional two years if the permittee was unable, with the exercise of reasonable diligence, to determine the existence or workability of coal deposits in the area to which the permit applied. Permittees were entitled to preference right leases if it could be demonstrated that the lands contained coal in commercial quantities.

Lands containing known coal deposits were not subject to prospecting permits. Instead, the lands were divided into leasing tracts and leases were awarded competitively. The competitive leasing system adopted by the Department was to award leases to the highest bidder. A lump sum cash bonus was collected at the time the lease was awarded.

The Mineral Leasing Act of 1920 restricted the acreage that could be held by one party in one state. Originally, the law allowed only one lease per person in each state. The limits were raised several times until, in 1964, they allowed a holding by any person of up to 46,080 acres (72 square miles) in one state.

Another feature of the act was the requirement that leases be issued for an indeterminate period as long as conditions of diligent development and continuous operations were satisfied. These conditions could be waived if operations were interrupted by strikes, the elements, or casualties not attributable to the holder of the lease. Lease terms and conditions became subject to readjustment at the end of 20-

TABLE 1-2

ACQUISITIONS OF THE PUBLIC DOMAIN, 1781-1867

ACQUISITION	AREA			COST ^(a)
	LAND (acres)	INLAND WATER (acres)	TOTAL (acres)	
State Cessions (1781-1802)	233,415,680	3,409,920	236,825,600	\$ 6,200,000
Louisiana Purchase (1802)	523,446,400	6,465,280	529,911,680	23,213,568
Red River Basin	29,066,880	535,040	29,601,920	---
Cession from Spain (1819)	43,342,720	2,801,920	46,144,640	6,674,057
Oregon Compromise (1846)	180,644,480	2,741,760	183,386,240	---
Mexican Cession (1848)	334,479,360	4,201,600	338,680,960	16,295,149
Purchase from Texas (1850)	78,842,880	83,840	78,926,720	15,496,448
Gadsden Purchase (1853)	18,961,920	26,880	18,988,800	10,000,000
Alaska Purchase (1867)	365,481,600	9,814,400	375,296,000	7,200,000
Total public domain	1,807,681,920	30,080,640	1,837,762,560	85,079,222

(a) Cost data for all except "State Cessions" obtained from: Reference Number 16.

Source: Reference Number 17.

TABLE 1-3
DISPOSITION OF PUBLIC LANDS, 1781-1963

TYPE OF DISPOSITION	ACRES
Disposition by methods not elsewhere classified ^(a)	301,800,000
Granted or sold to homesteaders ^(b)	287,300,000
Granted to States for:	
Support of common schools	78,600,000
Reclamation of swampland	64,900,000
Construction of railroads	37,200,000
Support of miscellaneous institutions ^(c)	22,300,000
Purposes not elsewhere classified ^(d)	118,000,000
Canals and rivers	6,100,000
Construction of wagon roads	3,400,000
Total granted to States	330,500,000
Granted to railroad corporations	94,300,000
Granted to veterans as military bounties ^(e)	61,000,000
Confirmed as private land claims ^(f)	34,000,000
Sold under timber and stone law ^(f)	13,900,000
Granted or sold under timber culture law ^(g)	10,900,000
Sold under desert land law ^(h)	10,100,000
Grand total ⁽ⁱ⁾	1,143,800,000

(a) Chiefly public, private, and preemption sales, but includes mineral entries, scrip locations, sales of townsites and townlots.

(b) The homestead laws generally provide for the granting of lands to homesteaders who settle upon and improve vacant agricultural public lands. Payment for the land is sometimes permitted, or required, under certain conditions.

(c) Universities, hospitals, asylums, etc.

(d) For construction of various public improvements (individual items not specified in the granting acts), reclamation of desert lands, construction of water reservoirs, etc.

(e) The Government has confirmed title to lands claimed under valid grants made by foreign governments prior to the acquisition of the public domain by the United States.

(f) The timber and stone laws provided for the sale of lands valuable for timber or stone and unfit for cultivation.

(g) The timber culture laws provided for the granting of public lands to settlers on condition that they plant and cultivate trees on the lands granted. Payment for the lands was permitted under certain conditions.

(h) The desert land laws provide for the sale of arid agricultural public lands to settlers who irrigate them and bring them under cultivation.

(i) The above figures have been rounded so that the totals may not equal the sum.

Source: Reference Number 18.

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year periods. In addition, leases could not be assigned or sublet without the consent of the Secretary of the Interior.

Other major provisions of the Mineral Leasing Act were:

- Leases could be modified by an additional 2,560 contiguous acres.
- Additional tracts up to 2,560 acres could be leased if workable deposits of coal would be exhausted within 3 years.
- Single leases could contain noncontiguous tracts.
- Royalties were set at not less than 5 cents a ton of coal.
- Annual rentals were set at not less than 25 cents, 50 cents, and \$1 for the first, third through fifth, and sixth year onward from lease issuance, respectively.
- Limited licenses or permits could be issued to municipalities (without royalties) if the coal mined was sold without profit to local residents.

1.2.2 1971 Leasing Moratorium

Prior to 1970, the Department's coal leasing policy was reactive in nature. Lease requests were processed on a case-by-case basis. Particularly between 1955 and 1970, there was little consideration given to the total coal reserves under lease or to the need for additional leasing, and environmental impacts of leases were not addressed.

A 1970 Bureau of Land Management (BLM) study [1] reported that leased coal acreage on public lands in six western states - Colorado, New Mexico, North Dakota, Montana, Utah, and Wyoming - rose sharply from roughly 80,000 acres in 1945 to about 788,000 acres in 1970, but that Federal lease production dropped from 10 million tons of coal to 7.4 million tons in those same years. Of the total acreage under lease, over 90 percent was not producing coal.

As a result of this internal Departmental study, the Secretary of the Interior, in 1971, directed BLM to halt the issuance of coal leases and prospecting permits. Similar conclusions on leasing problems were reached in a 1974 report by the Council on Economic Priorities [7].

1.2.3 Short-Term Leasing Since 1973

The informal 1971 moratorium was replaced in February 1973 with a new coal leasing policy that embodied both short-term and long-term actions.

The long-term actions were to develop a comprehensive planning system to determine the size, timing, and location of future coal leases and to prepare an environmental impact statement for its entire Federal coal leasing program.

The short-term actions included a complete moratorium on the issuance of new prospecting permits and a near-total moratorium on the issuance of new Federal coal leases. New leases would be issued only to maintain existing mines or to supply reserves for production in the near future. BLM issued instructions implementing this short-term policy in July 1973. The instruction stated that the decision to issue new leases would be based upon sufficient indications that a prospective lessee needs coal to satisfy an existing market and intends to begin development within three years.

Between 1974 and 1977, ten leases, covering 30,246 acres, were issued (see Table 1-4). Seven of these leases were producing coal by the end of 1977.

1.2.4 1975 Federal Coal Leasing Environmental Impact Statement

As part of its long-term leasing policy, the Department, in May 1974, issued a draft programmatic environmental impact statement [2]. Approximately 2,100 sets of the two-volume draft statement were distributed to Federal and state agencies, U.S. Senators and Representatives, industry organizations, conservation groups, and others. Local public hearings were held and 117 formal comments on the draft statement were received.

Comments and testimony were received from a diverse group of individuals, organizations, companies, and agencies. Comments ranged from support of the statement to requests for a complete rewrite. However, two areas of major concern were readily apparent. These were the need (1) for a more detailed description of the proposed Federal coal leasing program, and (2) to further analyze whether additional Federal coal should be leased in light of the large acreage and coal reserves presently under lease but on which no development had taken place.

The focus of the draft statement was on implementation of a new coal leasing system entitled the Energy Minerals Allocation Recommendation System (EMARS I). As described in the draft environmental statement, EMARS I was a three-part system: (1) allocation, (2) tract selection, and (3) leasing.

During the allocation process, Federal agencies were to relate inventoried Federal coal resources to projections of coal-related energy needs. Total national energy needs were to be disaggregated into regional demands for coal. In the tract selection phase, Federal coal leasing targets would be established in each coal region. These targets would be derived in part from total national projections for coal-based energy needs. Tracts would be selected to meet the leasing targets. The leasing phase was to begin with detailed pre-planning of the coordinated mining and rehabilitation factors required for reclamation and subsequent surface resource management. This last phase would conclude with pre-sale evaluations, lease sales, post sale evaluation procedures, and, finally, lease issuance.

The Department's final programmatic Environmental Impact Statement [3] was released in September 1975, salient features of which are discussed briefly below.

EMARS I was modified and retitled the Energy Minerals Activity Recommendation System (EMARS II). The three phases of this revised leasing system became: (1) nominations and programming, (2) scheduling, and (3) leasing. While the system envisioned in the draft statement emphasized Interior Department identification of coal reserves to be considered for leasing, the revised EMARS II program involved annual industry nominations and public identification of areas of concern. Nominations would be accepted for any area, with industry providing information on where and how much coal to lease. Based on these nominations, the Department would prepare land use plans and environmental analyses, resolve or mitigate resource conflicts, and hold lease sales if coal development was found to be compatible with the environment. The reasons behind the changes in the program between draft and final statements were not provided.

The following points were offered in the final environmental impact statement to support continued leasing:

TABLE 1-4

INFORMATION ON LEASES ISSUED BETWEEN 1974 AND 1978

DATE OF ISSUANCE	STATE/ COUNTY	METHOD OF MINING	ACRES CURRENTLY UNDER LEASE	BLM SURFACE CONTROL ACRES	U.S. FOREST SURFACE CONTROL ACRES	OTHER FEDERAL SURFACE CONTROL ACRES	NON-FEDERAL SURFACE CONTROL ACRES
1974	KY-McCreary	Underground	1,544	-----	1,544	-----	-----
1974	UT-Emery	Underground	1,360	-----	1,360	-----	-----
1974	AL-Fayette	Underground	2,388.24	-----	-----	-----	2,388
1974	PA-Indiana	Underground	50.62	-----	-----	51	-----
	PA-Indiana	Underground	29.66	-----	-----	30	-----
1975	KY-Clay	Underground	361.83	-----	362	-----	-----
1975	CO-Routt	Both	474.93	-----	-----	-----	475
1976	WY-Sweetwater	Surface	14,902.11	14,822	-----	-----	80
1977	UT-Sevier	Underground	8,823.88	295	8,528	-----	-----
1978	CO-Delta	Surface	310.51	311	-----	-----	-----
			30,245.78	15,428	11,794	81	2,943

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- Changing economic conditions made it probable that much of the coal under lease in 1975 was no longer suitable for development.
- Diligence requirements extended to existing leases would cause production or relinquishment over a period of a few years.
- Additional leasing might be required to avoid increases in energy costs.
- Some existing leases might be environmentally unsuitable for development, and leasing in new areas might be substituted for leases in unsuitable areas, thereby decreasing the relative value of the latter leases and possibly causing their relinquishment.
- Additional leasing would provide access to firms interested in penetrating new market areas but not currently holding Federal coal leases.

Analysis of the environmental impacts associated with the leasing program was quite brief in the final environmental impact statement.

Following the decision in *NRDC v. Hughes* (see section 1.2.6), the Department, in November 1977, solicited comments on the final statement, including the following questions:

- Is there a need for renewed Federal coal leasing?
- If there is a need, how should the leasing program be defined?
- If new Federal leasing should be undertaken, how would different types of Federal leasing programs affect the environment?

Over 100 comments were received from Federal agencies, state and local governments and agencies, coal industry representatives, and private individuals and organizations. Comments included criticisms of the final environmental statement and suggestions on preparation of an improved statement, as well as responses to the three questions listed above. Major suggestions offered for an improved statement included:

- Further analyses of the need for renewed Federal coal leasing and a clearer description of the proposed leasing program.
- Detailed analysis of potential environmental, social, and economic impacts of renewed leasing and alternative leasing programs.
- Consideration of current data and recent legislation (e.g., the Surface Mining Control and Reclamation Act of 1977, Federal Coal Leasing Amendments Act of 1976, and 1977 Amendments to the Clean Air Act).
- Consideration of the impacts of processing, transportation, and ultimate use of coal.
- Improved consideration of alternative energy sources (e.g., nuclear, solar, geothermal, wind, and conservation)
- Consideration of State coal-related policies.
- Definition of the role of more detailed regional and site-specific environmental statements.

The court order in *NRDC v. Hughes* directed the Department to prepare and publish a draft supplement to the final statement to correct the defects found by the court to exist, and to respond to the significant issues raised in comments previously received on the draft and final statements.

Prior to the entry of the order, the Department had already begun to review its coal management policies and activities and to determine what, if any, coal management program it should adopt. As a result of this internal review process, the Department prepared a series of option papers on the various elements which might comprise a coal management program. In a series of decisions beginning in October 1977 and concluding in November 1978, the Secretary and Under Secretary chose what is described in this statement as a preferred Federal coal management program. Because the Department's preferred program alternative is no longer the EMARS II program described in the 1975 statement and because there have been significant changes in statutory and Presidential policy and in available data, particularly as to the need for new coal leasing, the Department decided not to prepare a supplement to the original environmental impact statement but to write an entirely new statement. Both departmental and public review will be aided by a new statement. To the extent an entirely new integrated statement has been prepared instead of a supplement, the Department has exceeded the court's requirements. This statement responds to all the major concerns expressed about and corrects the faults previously found in the 1975 statement. Table 8-1 lists all significant categories of comments and shows where in the text the relevant material is found.

1.2.5 *Sierra Club v. Kleppe*

The decision in *Sierra Club v. Kleppe*, 427 U.S. 390 (1976), was the Supreme Court's first extensive treatment of NEPA's impact statement requirements as they concern the Department's coal-related activities. As such, it provides constructive background to the discussion in Chapter 3 of this statement on the Department's policy options for incorporation of environmental analyses into the evolving Federal coal management program.

The litigation began in July 1973. The plaintiffs contended that the Federal agencies could not allow further coal development in the Northern Great Plains Region (encompassing portions of four states - northeastern Wyoming, eastern Montana, western North Dakota, and western South Dakota) without preparing a comprehensive environmental impact statement for the entire region. The United States Court of Appeals for the District of Columbia Circuit found that there was no Federal regional plan or program for coal development in the Northern Great Plains Region. Nevertheless, the court concluded that the involved Federal agencies "contemplated" such a regional plan. The agencies were ordered to inform the District Court of their role in the further development of the region; if they decided to control that development, an impact statement would be required. The Court of Appeals also enjoined the Department of the Interior from approving the four mining plans analyzed in the multiproject Eastern Powder River Coal Basin Regional Impact Statement, which covered only a two-county area in Wyoming.

The Court further proposed a four-part balancing test for determining when preparation of an environmental impact statement must begin during contemplation of a plan or action. Factors to be considered were:

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- Likelihood that the program would soon be initiated.
- Extent to which information is available on the effects of program implementation.
- Extent to which irreversible commitments of resources are being made or options precluded.
- Severity of resultant environmental impacts.

In reversing the Court of Appeals decision, the Supreme Court held that NEPA did not require a "regional" environmental impact statement for the Northern Great Plains area where no proposed action was pending. It also found that an environmental impact statement is not required until the time at which a Federal agency makes a recommendation or report on a proposal for Federal action. Mere contemplation of action does not trigger the need for a statement and, thus, the Court of Appeals balancing test had no statutory authority. It further indicated that NEPA may require comprehensive statements where several related projects are pending at the same time, although an individual project may proceed where covered by an adequate statement. Finally, the Court noted that the choice of a region to be covered is largely that of the agency.

1.2.6 NRDC v. Hughes Decision

On September 27, 1977, the U.S. District Court for the District of Columbia ruled in *NRDC v. Hughes* (cited previously) that the 1975 final coal leasing programmatic environmental impact statement was inadequate and enjoined the Department from "taking any steps whatsoever directly or indirectly to implement the new coal leasing program including calling for the nominations of tracts for Federal coal leasing and issuing any leases, except when the proposed lease is required to maintain an existing mining operation at the present levels of production or is necessary to provide reserves needed to meet existing contracts and the extent of the proposed lease is not greater than is required to meet these two criteria for more than three years in the future." The court stated that the standard should be applied to both noncompetitive preference right lease applications (PRLAs) and competitive leases.¹

In addition, the court ordered the Department to issue an official press release, publish a notice in the *Federal Register*, and take other steps appropriate to receive additional comments on the 1975 statement. The Department was further ordered to prepare a draft supplement to the 1975 statement, receive comments on the supplement, and prepare a new final statement. These documents were to discuss the issues which the court identified as being deficient.

Although the Department initially filed a notice of appeal of the Court's decision, the District Court approved a settlement of the case on June 14, 1978. The modified order permits substantially more leasing before the final new programmatic environmental impact statement is issued than would have been allowed under the Court's initial standards.

¹The rights of holders of PRLAs was recently addressed in related litigation. The issue in *NRDC v. Berkland*, Civil Action No. 75-0313, was whether the Secretary's duty to issue a noncompetitive lease to an otherwise qualified holder of a PRLA is mandatory or discretionary. The United States District Court for the District of Columbia ruled, on June 30, 1977, that the Secretary does not have discretion to reject PRLAs where coal has been found in commercial quantities. It also affirmed the validity of the May 7, 1947, regulations, 42 Fed. Reg. 18848 and, in particular, the point that the cost of

The agreement will remain in effect until the injunction is lifted. Utah Power and Light Company has appealed the settlement to the Court of Appeals for the District of Columbia.

The agreement embodied in the amended order permits leasing under any of the following six standards:

By-pass leases are permitted where Federal coal may be otherwise lost if it is not developed by an existing mine because subsequent costs (either economic or environmental) would be much higher. Up to five years of reserves may be included in a lease issued under this provision. To qualify for a lease, mining operations must have been in existence on September 27, 1977.

Employment leases may be issued in order to maintain production and employment in existing mines on September 27, 1977, which are running short of reserves needed to maintain past production or where additional reserves are needed to meet existing contracts. Up to eight years of reserves may be included in a lease under this provision.

ERDA project leases of no more than 500,000 tons annual production may be issued to support Energy Research and Development Administration (ERDA) projects authorized under section 908 of SMCRA. Leasing is allowed if the technology assessed cannot be demonstrated on existing leases or private coal holdings.

Lease exchanges are permitted to implement exchanges for Federal leases in alluvial valley floors under section 510(b)(5) of SMCRA.

Hardship Leases involve seven particular lease applications specified in the agreement as being not subject to the injunction regardless of any other particular standard. The basis for these leases varies, but each has some special circumstance or hardship which justified proceeding with lease issuance in advance of the completion of the final version of this statement.

Noncompetitive (preference right) lease applications may be processed but not issued for the 20 PRLAs having the least environmental impact. Preference is to be given to PRLAs for tracts containing 90 percent of reserves which can be mined by deep mining and PRLAs for tracts which would not require substantial additional transportation facilities or water storage or supply systems in the regions. All activities, including completion of the commercial quantities test and necessary environmental analyses, are permitted under this standard.

In addition to the six standards, the agreement allows the Department to process but not issue a lease based on an application by the Edison Development Corporation.

Although the total amount of coal to be leased under all of these provisions cannot be stated precisely, the Department estimates as many as 35 leases involving a total of 275 to 300 million tons of coal reserves could be involved. If these leases were granted, the increased annual production from Federal lands could be as much as 13 to 17 million tons. The present

complying with lease terms is properly a part of a commercial quantities showing. However, if the issuance of a PRLA would constitute a major Federal action significantly affecting the quality of the human environment, an environmental impact statement must first be prepared. The plaintiffs (Natural Resources Defense Council and three other groups) and intervenor defendants, Utah Power and Light Company and Chaco Energy Company, have appealed this decision to the Court of Appeals for the District of Columbia. The Court is not expected to decide this case until late in 1979.

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annual coal production from mines on or including Federal leases was approximately 96 million tons during calendar year 1977.

The modified order will enable the Department to achieve production in areas where needs are critical and to avoid unnecessary loss of Federal coal resources in by-pass situations. In addition, the settlement allows the Department to continue with the overview portion of the regional environmental impact statements. Although only lease proposals meeting the revised short-term standards will be studied on a site-specific basis, the regional environmental impact statements will address the social, economic, and environmental effects of increased coal production in particular areas, including impacts which could occur under various leasing levels. This information will be useful both to this programmatic environmental impact statement and to subsequent program decisions.

1.3 CONSTRAINTS ON AND AUTHORITIES FOR COAL MANAGEMENT PROGRAM

This section presents an overview of the major laws and regulations and the programs of Federal agencies which influence the development of Federal coal resources. Primary emphasis is on statutes which directly control leasing and mining activities. Other authorities are cited in less detail to provide a perspective on factors which may indirectly influence the demand for coal resources and the location and intensity of coal development and related activities.

1.3.1 Laws Governing Development of Federal Coal

1.3.1.1 Federal Coal Leasing Amendments Act of 1976. The Department's concern in the early 1970's with the efficacy of its coal management program was shared by the Congress, particularly as it related to deficiencies in the coal provisions of the Mineral Leasing Act of 1920. Major deficiencies of the 1920 Act are discussed below [8,9].

Speculation. While the 1920 Act provided for lease termination, few leases were ever cancelled. In addition, issuance of PRLAs made it possible to gain control of public resources for nominal payments to the Federal Government. Slightly less than half of all Federal leases were issued with no competitive bidding [7]. Consequently, holding companies and energy resource speculators have entered the market for Federal coal in large numbers.

Lease Concentration. In 1976, approximately 57 percent of Federal acreage under lease was held by 15 leaseholders [10].

Fair Return to the Public. Under preference right leasing procedures, no competitive sales were held and lessees who discovered commercial quantities of coal had only to pay minimum royalties and rentals. Also, although more than 50

² An LMU, simply stated, is an area of land that will be mined as a single unit. The statutory definition is "an area of land in which the coal resources can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of coal reserves and other resources. A logical mining unit may consist of one or more Federal leaseholds, and may include

percent of all leases had been offered competitively, 72 percent of the competitive sales had either no bidder or only one bidder [7].

Social and Economic Impacts. When areas were newly opened to large-scale mining, state and local governments had the responsibility of providing needed public services. The 1920 Act provided that monies returned to state government from lease sales were to be used only for schools and roads. This restriction made it difficult for affected areas to meet the needs of their new inhabitants. The attendant problems were exacerbated by the "boom-bust" economic cycle associated with rapid resource development in rural areas.

Maximum Economic Recovery. Some existing leases developed only the most easily reached surface deposits which yielded the highest profits. Other resources of coal less easily reached were sometimes left in place.

The Congress responded to these problems with the passage, over President Ford's veto, in August 1976 of the Federal Coal Leasing Amendments Act (FCLAA). The broad purpose of the FCLAA is to provide a more orderly procedure for the leasing and development of coal presently owned by the United States.

Among the most significant requirements of the FCLAA governing the award and development of Federal leases, are the following:

- All leasing must be by competitive bidding.
- Noncompetitive (preference right) leasing is abolished (subject to valid existing rights).
- Leases may be consolidated into logical mining units (LMUs) when needed to insure maximum economic recovery of the coal deposit; ² all LMU reserves must be mined within 40 years.
- Diligent development and continuous operation is required (except continuous operation may be waived upon payment of advance royalties).
- Leases to a single person are limited to 100,000 acres nationwide (as well as 46,080 acres in a particular state).

Economic, social, and environmental deficiencies inherent in the 1920 Act were also addressed in the FCLAA. Comprehensive land use plans or their equivalent are ordinarily required prior to leasing. State shares of royalties are raised to 50 percent, with a portion of the monies available not just for construction of roads and schools but also for a wide range of public services and facilities in impacted areas. Finally, public bodies are entitled to have reserved a reasonable number of leasing tracts for their own energy production.

1.3.1.2 Federal Lands Policy and Management Act of 1976. The dependence of the Bureau of Land Management on a vast number of outmoded public land laws (those enacted when disposal and largely uncontrolled development of the public domain reflected then-current Federal policy) greatly hindered its land management powers. The Bureau's difficulty

intervening or adjacent lands in which the United States does not own the coal resource, but all the lands in a logical mining unit must be under the effective control of a single operator, be able to be developed and operated as a single operation, and be contiguous."

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in carrying out its responsible land management policies was examined in detail in the late 1960's by the Public Land Law Review Commission (PLLRC). After 5 years of extensive investigations, the PLLRC submitted its final report [11] to the President and the Congress. A major recommendation of the Commission was that the policy of large-scale disposal of public lands reflected by the majority of statutes then in force should be revised and that future disposal of public lands should be limited to only those lands which will provide maximum benefit for the general public in non-Federal ownership. Federal ownership should be retained for those lands whose values must be preserved so that they may be used and enjoyed by all Americans. The Commission also emphasized the need to develop a clear set of goals for the management and use of public lands.

The Commission's work, among other things, led to the passage in October 1976 of the Federal Land Policy and Management Act (FLPMA). The purpose of FLPMA is to provide the first comprehensive statutory statement of purposes, goals, and authority for the use and management of about 448 million acres of Federally-owned lands administered by the Secretary of the Interior through the BLM.

Title II of FLPMA provides BLM with a statutory framework for land use planning for public lands (43 U.S.C. 1712). In the development of land use plans, BLM must:

- Use the principles of multiple use and sustained yield³
- Give priority to the protection of areas of critical environmental concern (such as historic, cultural, or scenic values, fish and wildlife resources, etc.).
- Consider present as well as future uses of public lands.
- Coordinate planning activities with those of Federal, state, and local agencies.

The Act also confirms that the BLM may continue to rely on existing plans if those plans comply with the mandates of the new Act.

The Act further liberalized the use of mineral revenues by states and local governments by providing that 50 percent of the funds received by the Federal government for the development of leasable minerals on Federal land, which the FCLAA had provided to the states and local governments, could be used for any public purpose and by establishing a program to provide low interest loans to states and local governments to be impacted by Federal land mineral development activities. Proposed regulations to carry out the loan program were recently published, 43 Fed Reg. 49018 (1978).

1.3.1.3 Surface Mining Control and Reclamation Act of 1977. SMCRA was passed in August 1977 in response to concern over the extensive environmental damage caused by all coal mining and to technological and economic changes which now favor surface over underground mining. By 1976, over 60 percent of the coal produced came from surface mines.

Surface coal mining activities have imposed large social and environmental costs in many areas of the country in the form of unreclaimed lands, diminished agricultural productivity, water pollution, erosion, floods, slope failures,

loss of fish and wildlife resources, and a decline in natural beauty.

In the western coalfields, many of which are in arid or semi-arid areas, the environmental problems associated with surface mining are significant. Erosion rates on western range lands are among the highest in the United States for upland areas not under cultivation. The arid climate provides minimal moisture for a protective vegetative cover, and once this fragile vegetative cover has been disturbed, its restoration is difficult [12]. Furthermore, in most of the western coalfields the coal beds which lie close to the surface are also aquifers. Removal of the coal by surface mining operations could intersect those aquifers which are the source of water for many wells. Flow patterns in such aquifers could be changed, resulting in reduced availability of water for other uses.

In passing SMCRA, the Congress recognized that many states already had laws to regulate surface coal mining operations. However, these laws were considered inadequate, or were not fully enforced. Most existing state laws and Federal regulations for surface mining and reclamation were inadequate in that they were tailored to suit ongoing mining practices, and did not require modification of mining practices to meet established environmental standards. Regardless of the adequacy of state mining and reclamation laws, the Congress felt that they were not fully enforced, partly from a lack of funding and manpower to adequately ensure compliance. As a result, violations of the law and regulations were frequent.

SMCRA, therefore, established uniform minimum Federal standards for regulating surface mining and reclamation activities throughout the country on both public and private lands, and for assuring adequate protection from the environmental impacts of surface mining in all States. The States can assume the primary responsibilities for administration and enforcement of the act under Federally-approved state programs. The Secretary must approve state programs; the Department will assume administrative responsibilities if a state program under the act is found to be inadequate.

The act has several features directly relevant to the coal management program. While FLPMA and FCLAA are applicable only to Federal coal and surface estates, SMCRA applies to all surface mining operations, whether Federal, state, or private. Thus, many of the prior advantages of developing private coal resources (such as reduced administrative burdens and related environmental and reclamation standards) have been eliminated. Of additional importance to this environmental impact statement are the act's provisions regarding environmental protection performance standards (section 515) and designation of areas unsuitable for surface coal mining (section 522). A synopsis of these sections follows.

Performance standards are minimum standards applicable to all surface coal mining and reclamation operations. These standards include:

- Maximum utilization and conservation of the solid fuel resource being recovered.

³ "Multiple-use" means the combination of resource values that consider changing needs and conditions, long-term needs for renewable and non-renewable resources, land productivity, environmental values, and economic

return. "Sustained yield" means the achievement and maintenance in perpetuity of a high-level output of public lands natural resources consistent with multiple use.

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- Restoration of disturbed land to support the same or better conditions.
- Restoration of the approximate original land contour.
- Stabilization and protection of all surface areas.
- Protection of prime farmlands through specific reclamation techniques.
- Minimization of disturbances to the existing hydrological balance.
- Limitation on mining of steep slopes.

Section 522 of SMCRA establishes a procedure to designate lands unsuitable for all or certain types of coal mining operations. The Secretary of the Interior determines unsuitability on Federal lands. The states have authority to determine unsuitability for non-Federal lands. Areas on both Federal and non-Federal lands may be designated unsuitable if, upon petition, it is determined that reclamation of disturbed lands is not economically or technologically feasible. Areas may also be classified unsuitable if mining operations will:

- Be incompatible with existing land use plans.
- Significantly affect important fragile or historic lands.
- Result in substantial loss or reduction in the productivity of renewable resource lands which produce food or fiber.
- Substantially endanger life and property in natural hazard lands.

Unsuitability designations must be preceded by a report addressing an area's potential coal resources, the demand for these resources, and the impact of designation on the environment, the economy, and the supply of coal. In addition, as part of its obligation under Section 522 and 523 of SMCRA, the Department of the Interior must review all Federal lands for unsuitability for all or certain types of coal development.

The environmental impact of suitability standards on a broad scale is discussed in the environmental impact statement prepared by the Department of the Interior's Office of Surface Mining Reclamation and Enforcement (OSM) in connection with its permanent program regulations [13,14]. The Federal Lands Program, including the Federal lands review required by section 522, is exempt from compliance with the requirements of NEPA for preparation of an environmental impact statement pursuant to section 702 of the SMCRA. The reason for the exemption is that the standards to be used under the Federal Lands Program will follow those proposed in the permanent program and the environmental analysis of that statement will generally cover the standards adopted by the Federal Lands Program. Since November 1977, the Department of the Interior has been developing unsuitability criteria for Federal lands. These are discussed in Chapter 3 and presented in the example regulations. Although these standards are exempt from NEPA's impact statement requirement, the effects of the tentative standards are discussed in this statement.

Other features of SMCRA relevant to the development of a Federal coal management program are:

- Authority to exchange Federal lands already under lease but which have been included in an alluvial valley floor and are subject to the grandfather clause in section 510(b)(5) of the act.

- A requirement for the consent of certain private surface owners before the Department can lease any Federal coal under privately-owned land.

Interim regulations under SMCRA were published in final form in December 1977 and will remain in effect until they are supplanted by a final set of permanent regulations.

1.3.1.4 Mineral Leasing Act for Acquired Lands. The Mineral Leasing Act for Acquired Lands, 61 Stat. 913; 30 U.S.C. 351, governs leasing on Federally-acquired lands. The Act requires the consent of the head of the Federal agency having administrative jurisdiction over the lands before BLM can lease the coal deposit. In addition, the land management agency may also sell or convey the land, subject to existing mineral leases. Otherwise, leasing provisions are the same as those for nonacquired lands.

1.3.1.5 Other Relevant Laws. Numerous other Federal laws regulate aspects of coal development and energy conversion. Pertinent laws are summarized in Table 1-5.

1.3.2 Interagency Relationships in Federal Coal Management

The jurisdictional interrelationships in a Federal coal management program are complex. Many Federal departments and agencies are involved through their specific mandates or related authorities. This section summarizes the major points of interaction both within and external to the Department of the Interior.

1.3.2.1 Department of Energy Coal-Related Functions. While many agencies across the Federal structure are involved in coal management activities, the Federal coal management program would be carried out by agencies in the Department of the Interior and the Department of Energy (DOE). The DOE was established in October 1977 following enactment of the Department of Energy Organization Act (DOE Act). The DOE Act was passed in response to the Nation's increasing shortage of nonrenewable energy resources and to the national security implications of increasing dependence on foreign energy supplies. Under the Act, many of the energy-related functions of a myriad of agencies were consolidated under a single departmental organization. It was envisioned that the reorganization would foster cooperation among Federal, State, and local governments in the development of national energy programs.

Prior to the passage of the DOE Act, the Department of the Interior had exclusive jurisdiction over Federal coal leasing decisions for public lands administered by the Department. However, the DOE Act transferred to the Department of Energy authority to promulgate regulations for:

- Fostering competition for Federal leases.
- Implementing alternative bidding systems for the award of Federal leases.
- Establishing diligence requirements for coal development operations on Federal leases.
- Setting rates of production for Federal leases.
- Specifying procedures, terms, and conditions for the acquisition and disposition of Federal royalty interests taken in kind.

TABLE 1-5

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

<u>Popular Name</u>	<u>Public Law/U.S. Code Citation</u>	<u>Purpose</u>	<u>Major Relevance</u>
Antiquities Act of 1906	59-209; 16 U.S.C. 431	<ul style="list-style-type: none"> *Regulates antiquities excavation and collection (including fossil remains). *Protects historical values on public land. 	<ul style="list-style-type: none"> *Mitigates potential harm to historical, archaeological, and paleontological resources.
Archaeological and Historical Preservation Act of 1974; Archaeological Salvage Act	93-291, 86-523; 16 U.S.C. 469	<ul style="list-style-type: none"> *Provides for recovery of data from areas to be affected by Federal actions. *Provides for preservation of data (including relics and specimens) at every Federal construction project. 	<ul style="list-style-type: none"> *Mitigates potential harm to historical and archaeological, and paleontological resources. *Mitigates potential harm to historical and archaeological resources.
Bald Eagle Protection Act of 1969	86-70; 16 U.S.C. 668	<ul style="list-style-type: none"> *Protects bald eagle and eagle habitat. 	<ul style="list-style-type: none"> *May make certain coal lands unsuitable for development.
Clean Air Act Amendments of 1977	95-95; 42 U.S.C. 7401	<ul style="list-style-type: none"> *Establishes requirements for areas failing to attain National Ambient Area Quality Standards (NAAQS). *Provides for prevention of significant deterioration of areas where air is cleaner than NAAQS. 	<ul style="list-style-type: none"> *Limits industrial development within and adjacent to areas exceeding NAAQS and areas preserving clean air quality. *Reduces commercial attractiveness of low-sulfur Western coal as new source standard changed to percent emissions reduction.

TABLE 1-5 (Continued)

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

<u>Popular Name</u>	<u>Public Law/U.S. Code Citation</u>	<u>Purpose</u>	<u>Major Relevance</u>
Clean Air Act Amendments of 1977 (Con't.)		*Modifies 1970 air act provisions regarding Federal facilities; enforcement strategies; coal utilization impacts; and interstate air pollution.	
Clean Water Act of 1977	95-217; 33 U.S.C. 1251	<ul style="list-style-type: none"> *Establishes effluent limitations for new and existing industrial discharges into U.S. waters. *Limitations set for public treatment discharges; with pretreatment by industrial users. *Provides mechanism to restore and maintain integrity of the nation's waters. 	<ul style="list-style-type: none"> *May reduce development options in areas where anti-degradation policy restricts discharges into high quality waters. *Treatment facilities in areas with rapidly expanding infrastructures must meet water quality standards. *Effluent standards apply to coal mining point sources.
Endangered Species Act of 1973	93-205; 16 U.S.C. 1531	*Protects endangered and threatened species and critical habitat from Federal activities. Requires prior consultation with Fish and Wildlife Service.	*May make certain coal lands unsuitable for development.
Fish and Wildlife Coordination Act of 1934	85-624; 16 U.S.C. 661	*Requires consultation about water resource development actions which might affect fish or associated wildlife resource.	*Mitigates potential Federal coal development impacts.

TABLE 1-5 (Continued)

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

<u>Popular Name</u>	<u>Public Law/U.S. Code Citation</u>	<u>Purpose</u>	<u>Major Relevance</u>
Historic Preservation Act of 1966	89-665; 16 U.S.C. 470	<ul style="list-style-type: none"> *Establishes system of classifying properties on or eligible for inclusion on Historic Register. *Mandates Federal agency consultation with Advisory Council and State historic preservation officers. 	<ul style="list-style-type: none"> *Mitigates potential harm to historical and archaeological values.
National Environmental Policy Act of 1969	91-190; 42 U.S.C. 4321	<ul style="list-style-type: none"> *Makes environmental protection part of the mandate of every Federal agency. *Requires impact statements for major Federal actions with potentially significant impacts. 	<ul style="list-style-type: none"> *Provides legislative authority to control energy development on environmental grounds. *Impact statement process must be integral part of coal leasing system.
Mining and Minerals Policy Act of 1970	91-631; 43 U.S.C. 21	<ul style="list-style-type: none"> *Declares Congressional Minerals Policy. 	<ul style="list-style-type: none"> *Provides broad, general principles for mineral resource development.
Noise Control Act of 1972	92-574; 42 U.S.C. 4901	<ul style="list-style-type: none"> *Requires publication of information on limits of noise required to protect public health and welfare. *Preempts local control of railroad equipment and yard noise emissions. 	<ul style="list-style-type: none"> *Regulations may be proposed to control coal mining areas and activities.
Resource Conservation and Recovery Act of 1976	94-580; 42 U.S.C. 6901	<ul style="list-style-type: none"> *Establishes guidelines for collection, transport, separation, recovery and disposal of solid waste. 	<ul style="list-style-type: none"> *Mining locations may be affected by EPA regulations governing disposal of coal mining wastes.

TABLE 1-5 (Continued)

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

<u>Popular Name</u>	<u>Public Law/U.S. Code Citation</u>	<u>Purpose</u>	<u>Major Relevance</u>
Resource Conservation and Recovery Act of 1976 (Cont.)		<ul style="list-style-type: none"> *Creates major Federal hazardous waste regulatory program. *Provides assistance to establish state or regional solid waste plans. 	<ul style="list-style-type: none"> *Coal industry faced with stringent permit requirements if coal wastes classified by EPA as hazardous.
Safe Drinking Water Act of 1977	95-190; 42 U.S.C. 300	<ul style="list-style-type: none"> *Establishes mechanism for National Primary Drinking Water Standards. 	<ul style="list-style-type: none"> *EPA conducting study of the impacts of pits, ponds, lagoons, etc. on underground water supplies for public water systems.
Soil and Water Resources Conservation Act of 1977	95-192; 16 U.S.C. 2001	<ul style="list-style-type: none"> *Requires appraisal by Secretary of Agriculture of information and expertise on conservation and use of soils, plants, woodlands, etc. 	<ul style="list-style-type: none"> *Provides opportunity for expanded data base.
Multiple-Use Sustained Yield Act of 1960	86-519; 16 U.S.C. 528	<ul style="list-style-type: none"> *Requires management of national forests under principles of multiple use so as to produce a sustained yield of products and services. 	<ul style="list-style-type: none"> *Mandates land management practices similar to those required under the Department's coal management program.
National Forests Management Act of 1976	95-233; 16 U.S.C. 472a	<ul style="list-style-type: none"> *Establishes guidelines for the Secretary of Agriculture for the sale of forest products from the national forest system. 	<ul style="list-style-type: none"> *Principles should be considered in BLM's land use planning process.

TABLE 1-5 (Concluded)

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

<u>Popular Name</u>	<u>Public Law/U.S. Code Citation</u>	<u>Purpose</u>	<u>Major Relevance</u>
Department of Energy Organization Act of 1977	95-91; 42 U.S.C. 7101	<ul style="list-style-type: none"> ° Transfers authority to issue some coal regulations from DOI to DOE, including production regulations. ° DOE determines long-term national coal production goals. 	<ul style="list-style-type: none"> ° Limits coal management authority exercised by the Department of the Interior. ° Requires program to establish proper coordination mechanisms.

INTRODUCTION AND BACKGROUND

Activities specified in the DOE Act for which the Secretary of the Interior will remain solely responsible are:

- Issuance and supervision of Federal leases.
- Enforcement of all regulations applicable to leasing of mineral resources, including but not limited to lease terms and conditions and production rates.

The Department is also required to provide DOE not less than 30 days in which to disapprove any newly proposed lease term or condition which relates to any matter, upon which DOE has authority to promulgate regulations under the DOE Act. No such term or condition may be included in a lease if it is disapproved. Reasons for such disapproval and acceptable alternatives must be furnished in writing to the Department of the Interior by DOE.

The DOE is required to consider and establish energy production, use, and conservation goals, for periods of 5, 10 and 15 years, necessary to satisfy projected energy needs of the United States. These goals are considered as objectives for the national production of energy resources which are necessary to carry out national energy policy. These production goals are to be included in the proposed National Energy Plan (which is to be transmitted to the Congress no later than April 1, 1979) and are to be reviewed biennially. Section 802 of the Act provides procedures for the Congress to enact legislation regarding the National Energy Plan which may contain appropriate alternatives to, modifications of, or additions to the proposed Plan submitted by the President. Department of Energy and Department of the Interior production goal setting procedures for national energy resources, including coal, from Federal lands between the two Departments have been established in a memorandum signed in September 1978. A copy of this Memorandum of Understanding by the two Secretaries is included in Appendix B.

1.3.2.2 DOE-Interior Leasing Liaison. When DOE was organized in the Fall of 1977, the Office of Leasing Policy Development was established and staffed to manage DOE's responsibilities for participating in Federal energy leasing programs. This office is responsible for drafting regulations to implement leasing responsibilities addressed in the prior section and for fostering close coordination with the Department of the Interior and other agencies.

The Department of Energy's Office of Coal Supply Development was established to monitor, from a broad viewpoint, restraints on coal supply. The office has no direct mandate in coal leasing, but has been reviewing coal supply as a system. Its aim is to isolate potential constraints and attempt to ameliorate these by alerting appropriate policy offices and by drafting corrective legislation. Some subjects currently under study by the office include: the effect of SMCRA on coal production; transportation problems (rising rates, equipment shortages); manpower demand in the mines; coal leasing (or lack of it) as a potential constraint for competition; and constraints in supply from growing production costs.

A Leasing Liaison Committee was authorized by the DOE Organization Act. This committee has been established and now serves as an executive level coordinating mechanism on Federal energy leasing and other interagency energy programs. Both DOE and Interior are represented by four policy level representatives on the Committee.

1.3.2.3 Department of the Interior's Coal Management Functions. The division of the Department of the Interior's functions and responsibilities concerning management of Federal coal between the the Office of Surface Mining Reclamation and Enforcement (OSM), the Geological Survey (GS), and BLM were revised in a memorandum signed by the Assistant Secretary, Land and Water Resources, and the Assistant Secretary, Energy and Minerals, in July 1978. Table 1-6 presents the three agencies' extensive coal management responsibilities. The table is divided into three sections—Pre-leasing Functions, Post-leasing Pre-Mining Functions, and Functions and Responsibilities During Mining Operations. It indicates the prime responsibility, joint responsibility, consulting, and concurrence requirements of the departmental agreement.

Regulation of coal development on Federal leases is shared by the OSM and the GS. OSM administers the Department's program to mitigate the adverse effects of surface coal mining and to reclaim land which has been adversely affected. OSM's jurisdiction extends to the surface effects of underground coal mining operations. OSM's enabling statute, the SMCRA, is a complex and exceptionally detailed piece of legislation which gives the agency little discretion in the design of its regulatory program.

The SMCRA Act establishes a two-tiered program for the regulation of surface coal mining and the surface effects of underground coal mining on both private and Federal lands. The first phase of this regulatory program went into effect on private lands on December 13, 1977, upon publication of OSM's interim program regulations (30 CFR Part 700, Subchapter B)[15]. These regulations, among other things, put into effect those of the statute's environmental performance standards which Congress considered to be sufficiently critical to require almost immediate implementation. Examples of these standards are the requirement to return previously mined land to approximate original contours, to segregate topsoil, and to minimize the disturbance to the hydrological balance of both the mine site and associated off-site areas. The interim regulations also established OSM inspection and enforcement program. These interim performance standards, as well as OSM's inspection and enforcement program, were applied to Federal lands on September 21, 1978, upon publication by the Geological Survey of revisions to its coal mining operating regulations (30 CFR Part 211)[16].

OSM is currently developing its permanent regulatory program, which will be applicable to Federal lands 30 days after publication in the *Federal Register*. The permanent regulatory program will implement the statute's remaining environmental performance standards, as well as permit application requirements, bonding provisions and provisions for the designation of lands unsuitable for mining on Federal lands. Preproposed regulations were circulated in draft form for public comment this past summer and were the subject of several hearings. Proposed regulations were published on September 18, 1978 [17] and are now in the public comment phase of the rulemaking.

The GS establishes the Federal Government's royalty requirements, as well as development and mineral resources recovery requirements for Federal leases. Under its Part 211 regulations, the Geological Survey oversees coal exploration operations, reviews mine plans, and inspects mining

TABLE 1-6

DEPARTMENT OF THE INTERIOR

DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL
BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, GS AND BLM)

FUNCTION	PRIME RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
<u>PRE-LEASING FUNCTIONS</u>				
Evaluate coal resources	GS	---	---	---
Petition process for designation of Federal lands unsuitable for all or certain types of surface coal mining operations	OSM - Receives petitions - Conducts hearings - Issues decisions	Surface Management Agency and other appropriate State and local agencies	---	---
Federal coal lands review	BLM - applies criteria in determination of suitability	---	OSM, GS & other surface managing agencies	OSM - establishes ground rules and criteria for Federal coal lands review
Preparation of regional EIS or site-specific pre-lease EIS concerning lease tract selection	BLM lead agency (unless other agency designated lead agency) - Relating to lease tract selection	---	OSM, GS & other appropriate agencies and state and local interests	---
Preparation, special lease terms and conditions	BLM	---	OSM (responsibilities under SMCRA - to administer protection requirements of the act), GS (responsibilities under the MLA)	GS and OSM

TABLE 1-6 (Continued)
DEPARTMENT OF THE INTERIOR
DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL
BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, GS AND BLM)

FUNCTION	PRIME RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
Act as Secretary's official representative in dealing with lease applicants	BLM	---	---	---
Surface owner consent	BLM (lease tract selection function)	---	---	---
<u>POST-LEASING PRE-MINING FUNCTIONS</u>				
Prepare recommendations on applications for use of Federally owned surface over leased coal for rights not granted in Federal coal lease	BLM	OSM & GS (BLM receives applications) - prior to receipt of coal mining plan it is solely GS responsibility to report on surface use application	GS before mining plan; OSM after mining plan filed.	---
Delineation of "permit area"	None until mining plan filed. Then OSM assumes responsibility with concurrence of BLM and GS	---	---	BLM and GS
Review, approval of mining plans and major modifications; lead agency for preparation of site specific EA/EIS and coordination with other agencies outside DOI	OSM has lead responsibility (formerly assigned to GS, became essential function of OSM under Sec. 201, SMCRA)	BLM and GS	BLM regarding special requirements relating to protection of natural resources; GS regarding responsibilities relating to development, production and resource recovery requirements.	GS on production and recovery requirements
Exploration on leased coal lands outside a permit area	GS receives application and supervises operations for all exploration outside a permit area	---	OSM	---
Exploration on leased coal lands within a permit area	OSM	OSM and GS coordinate a data exchange	GS	GS

TABLE 1-6 (Continued)

DEPARTMENT OF THE INTERIOR

DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL
BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, GS AND BLM)

FUNCTION	PRIME RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
Responsibility for all nonlessee activity on lease land prior to operations	BLM	---	---	---
Responsibility for determining performance bond	OSM (BLM for interim period)	---	---	---
<u>FUNCTIONS AND RESPONSIBILITIES DURING MINING OPERATIONS</u>				
Act as Secretary's representative in dealing with lessees and/or operators during operations	OSM (formerly GS & BLM)	GS retains production functions; OSM assumes environmental and enforcement functions; BLM retains nonmining functions, outside the permit area, including rights-of-way and ancillary activities related to mining. GS & BLM inspection in connection with GS, BLM functions, are coordinated with OSM inspections (except BLM inspections outside the permit area). GS makes royalty audits and other nonfield inspections independent of OSM.	---	---
Take necessary action in emergency environmental situation	OSM (formerly GS & BLM)	OSM has primary emergency authority; BLM & GS have such authority when OSM inspectors are unable to take action before significant harm or damage will occur.	---	---

TABLE 1-6 (Conclusion)

DEPARTMENT OF THE INTERIOR

DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL
BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, GS AND BLM)

FUNCTION	PRIME RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
		GS & BLM retain their present procedures for emergencies involving loss, waste, or damage to coal and other natural resources and to other MLA functions		
Conduct inspection prior to abandonment and specify and approve abandonment procedures	OSM (primary authority to approve abandonment procedures and approve abandonment of operations)	OSM, GS, BLM - all have joint abandonment inspection responsibility	Private surface owner, in case of private surface	BLM concurrence in approval of compliance, special requirements: protection of natural resources & post-mining land use of affected lands. GS concurrence: compliance with production and coal resource recovery requirements.
Release of reclamation bond (permanent program)	OSM	---	---	BLM & GS concurrence.
Release of lease bond	BLM	---	---	BLM & GS concurrence.

NOTE: These agencies will also consult with the U.S. Fish and Wildlife Service, both on a general basis such as during land-use planning and on a specific basis when required by laws such as The Endangered Species Act.

INTRODUCTION AND BACKGROUND

operations for compliance with its resource, conservation, development, and recovery requirements. The Geological Survey is currently revising its Part 211 regulations to be consistent with OSM's proposed permanent Federal lands regulations.

In those instances where a mining operation occurs on Federal lands in a state which has concluded a cooperative agreement with the Department under Section 523 of SMCRA, regulatory responsibility for Federal coal development, with respect to reclamation requirements, may be shared with that state. Both the Surface Mining Act and the Mineral Leasing Act of 1920, as amended, prohibit the Secretary's delegating to the states his responsibility for protection of the Federal Government's proprietary interest in the development of coal resources on Federal lands. Under these cooperative agreements, the states may review and approve mining plans concurrently with the Federal review of those plans and inspect mining operations on Federal lands. To date, the Secretary has concluded cooperative agreements with the States of Utah, Wyoming, and Montana. Negotiations are in progress with the States of New Mexico, Colorado, and North Dakota. If these latter three states are unable to conclude successful negotiations with the Department to modify their cooperative agreements, their existing agreements will terminate on November 22, 1978.

The BLM has the principal responsibility for carrying out the requirements of FCLAA. It prepares the required land use plans and does land use analyses where Federal interests are not sufficient to justify a land-use plan. It has the responsibility to delineate, rank, and select lease tracts and to consult with surface owners over Federal coal. The BLM also conducts hearings or leasing proposals and prepares the necessary environmental analyses. It also carries out certain functions under SMCRA including the Federal lands review to determine which lands are unsuitable for all or certain types of coal mining.

The Department's Office of Coal Leasing, Planning and Coordination serves as the focal point for developing and carrying out the Department's coal policy review and related development of a program for management and leasing of Federally-owned coal resources in accordance with the President's directives in the National Energy Plan and Environmental Message (see Section 1.4.1). The Office is responsible for developing and coordinating Departmental policies affecting Federal coal management. It assists the Secretary, through the Assistant Secretary for Land and Water Resources, in implementing the Federal coal management responsibilities vested in the Department under the Mineral Leasing Act of 1920 and the Federal Coal Leasing Amendments Act of 1976.

Other Department agencies with lesser coal related responsibilities are the U.S. Fish and Wildlife Service, Bureau of Mines, Bureau of Reclamation, and Heritage Conservation and Recreation Service. The U.S. Fish and Wildlife Service conducts surface mining studies and monitoring relating to impacts on wildlife in general and on endangered species in particular. These studies are used to assess and predict the affects of coal-related activities on fish, wildlife, and their habitats on Federal, State, and private lands. For particular requirements on Endangered Species Act consultation, see 50 C.F.R. Part 402, 43 *Fed. Reg.* 870. The division of wildlife

related responsibilities in coal management between the U.S. Fish and Wildlife Service and the Bureau of Land Management was established in a Memorandum of Understanding signed on September 26, 1978, and is included in Appendix B.

Coal activities in the U.S. Bureau of Mines include developing advanced coal mine health and safety research and conducting demonstration projects on backfilling and subsidence.

1.3.2.4 Other Federal Agencies with Coal Related Responsibilities. Table 1-7 summarizes relevant coal management functions within the Federal structure. Policy and evaluation functions relating to coal, not previously addressed, are assigned within the Executive Office of the President to the Office of Management and Budget, the Council of Environmental Quality, the Domestic Policy Staff, the National Security Council, and the Office of Science and Technology Policy.

The Department of Agriculture, U.S. Forest Service, has been given added responsibility relating to coal management functions through the FCLAA. Under the Act, the Secretary of Agriculture has consent authority for Federal leases under his jurisdiction, and may add terms and conditions to coal leases on these lands to protect resource and environmental values. This authority extends to approval of mining and reclamation plans for Federal leases in National Forests.

New responsibilities have also been given to the Soil Conservation Service including assisting in the identification of prime farmlands within areas that may be surface mined in the future and reviewing and commenting on permits for surface mining which involve prime farmland. The Service is also authorized to review and comment on state reclamation plans.

Legislative organizations with coal management involvement are:

- Library of Congress, Congressional Research Service.
- General Accounting Office.
- Congressional Budget Office.
- Office of Technology Assessment.

These organizations provide research, monitoring, and oversight capabilities for the Congress.

1.4 EXISTING ENERGY POLICIES

1.4.1 Role of Coal in National Energy Policy

In April 1977, President Carter released the Administration's National Energy Plan (NEP), which combines legislative, administrative, and budgetary proposals aimed at solving the Nation's energy crisis. The following seven energy goals for 1985 were announced:

- Reduce total energy growth to below 2 percent year.
- Reduce oil imports below 6 million barrels a day.
- Reduce gasoline consumption by 10 percent from 1977 levels.
- Increase annual coal production by at least 400 million tons over 1976 levels.
- Insulate 90 percent of all buildings.
- Use solar energy in 2.5 million homes.
- Acquire a strategic oil reserve of 1 billion barrels of oil.

TABLE 1-7

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
1. Energy Department (including functions relating to coal from ERDA, FEA and FPC; and some from Interior)	Ass't Secretary, Energy Technology	Fossil Energy Program Office	*Coal mining technology development *Coal utilization R&D (e.g., gasification; liquefaction) *Coal cleaning technology
	Ass't Secretary, Resource Application	Fossil Energy Division	*Coal utilization technology demonstrations *Leasing of publicly-owned coal lands (with Interior) *Forced use of coal by utilities and industry through regulation *Coal loan guarantee program
	Ass't Secretary, Environment	Biomedical and Environmental Research Division Control Technology Division	*Biomedical and environmental effects research *Environmental control technology
	Administrator, Energy Regula- tory Administration	Energy Regulatory Administration	*Regulation, conversion to coal and use of coal *Regulation of gas from coal
	Administrator, Energy Informa- tion Administration	Energy Information Administra- tion	*Data collection and analysis relating to coal
	Director, Energy Research		*Coordinates all energy research, presumably including coal *Grants for University Coal Research Laboratories (title VIII of H.R. 2)

TABLE 1-7 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
2. Interior Department	Ass't Secretary, Energy and Minerals	Bureau of Mines	*Develop mining technology *Mine reclamation demonstrations *Coal mine health and safety R&D *Technology for cleaning coal
		Geological Survey	*Coal resource investigations *Coal hydrology investigations *Classification of publicly-owned lands *Regulation of operations on leased coal lands *Environmental studies related to coal
		Office of Surface Mining	*Regulate surface mining *Regulating surface effects of under- ground mining *Assistance to states for mining and reclamation programs *Assistance for state mining and mineral research institutes *Reclamation of abandoned mined areas *Develop mining technology, production, environment, health and safety
	Ass't Secretary, Land and Water	Bureau of Land Management	*Leasing and operations--publicly-owned coal lands (with DOE) *Environmental studies relating to coal

TABLE 1-7 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
3: Agriculture Department	Ass't Secretary, Fish and Wildlife and Parks	Office of Coal Leasing, Planning and Coordination	*Policy and program development responsibility
		Bureau of Reclamation	*Water project studies *Water availability
		U.S. Fish and Wildlife Service	*Surface mining studies relating to wildlife
		Forest Service	*Leasing and leasing operations on publicly-owned lands controlled by Department *Mined land reclamation program *Land management planning and environ- mental impact statements - National forests
	Ass't Secretary, Conservation, Research and Education	Soil Conservation Service	*Technical assistance on conservation planning, soil surveys, plant materials, river basin surveys, and hydrological studies
		Science and Education Administration	*Mined land reclamation research
		Rural Electrification Adminis- tration	*Loans and loan guarantees for electrical generating, transmission and distribution systems
	Ass't Secretary, Rural Develop- ment		

TABLE 1-7 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
4. Labor Department	Ass't Secretary, Mine Safety and Health	Mine Safety and Health Administration*	*Regulation of coal mine safety and health
	Ass't Secretary, Employment	Office of Workers' Compensation	*Pneumoconiosis benefits
5. Transportation Department		Federal Railroad Administration	*Railroad assistance programs, including revitalization, important to coal transportation
6. Commerce Department	Ass't Secretary for Economic Development	Economic Development Administration	*Assistance for planning for socio- economic planning for energy development
7. Health, Education and Welfare Department	Ass't Secretary for Health	National Cancer Institute National Institute for Environ- mental Health Sciences National Institute for Occupational Safety and Health	*Biomedical effects research *Biomedical and environmental effects relating to coal *Biomedical and environmental effects research (e.g., coal workers occupa- tional diseases)
8. Environmental Protection Agency (EPA)	Ass't Administrator Air and Waste Management	Office of Air Quality Planning and Standards	*Air quality standards and regulations
	Ass't Administrator, Water and Hazardous Materials	Office of Water Planning and Standards	*Water quality standards and regula- tions
		Office of Toxic Substances	*Toxic materials regulation
	Ass't Administrator, Enforce- ment	Office of General Enforcement Office of Water Enforcement	*Enforcement of EPA standards and regulations

*Formerly Mining Enforcement and Safety Administration (MESA)

TABLE 1-7 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
	Ass't Administrator, Research and Development	Office of Health and Ecological Effects	*Biomedical and environmental effects research
		Office of Energy, Minerals and Industry	*Environmental control technology development *Coal utilization R&D *Coal cleaning technology
9. Corps of Engineers	(Reports to Secretary of the Army)	Civil Works	*Waterways projects important to coal transportation *Regulation relating to standards and criteria on design, location, con- struction, maintenance, enlargement, modification, removal and abandonment of new and existing coal mine waste piles
10. Interstate Commerce Commission			* Regulation of railroads
11. Tennessee Valley Authority (TVA)			*Coal technology R&D (ammonia from coal) of activities (technology, economic assistance, etc.) *Purchases and uses large amounts of coal

TABLE 1-7 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
12. Treasury Department			*Tax policy and collection
13. Justice Department			*Litigation involving public lands
14. Housing and Urban Development			*Housing and development of new communities
15. Community Services Administration			*Assistance to solve economic problems in communities
16. Small Business Administration			*Small business loans for coal-related facilities, machinery, equipment
17. National Science Foundation			
<u>Other Independent Commissions</u>			
18. Federal Trade Commission			*Promotes fair competition; prevents restraint of trade, and price fixing
19. Securities and Exchange Commission			*Regulates public utility holding company systems; reviews mining disclosures
20. Federal Energy Regulatory Commission			*Has regulatory authority over gasification in interstate sales of power; establishes and enforces rates and charges for electric energy transmission and sale

TABLE 1-7 (Concluded)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
<ul style="list-style-type: none"> • And also various water resources and regional agencies and commissions: Water Resources Council, Susquehanna River Basin Commission, Delaware River Basin Commission, Missouri River Basin Commission, Regional Action Planning Commissions: Coastal Plains, Four Corners, Old West, Appalachian Regional Commission, Ozarks and Upper Great Lakes Regions, involved with coal and mining planning water resources, environmental and economic impacts, regional developments. • Activities of organizations and agencies within the Executive Office of the President such as: <ul style="list-style-type: none"> • The Office of Management and Budget (OMB) • The Domestic Policy Staff • Council on Environmental Quality (CEQ) • Office of Science and Technology Policy (OSTP) • Activities of the Departments of Treasury (e.g., tax policy and collections, proposed tax rebates for coal utilization facilities) and Justice (e.g., litigation involving public lands) • Activities of Ass't Secretaries and Administrators having major activities relating to coal but not in line program activities; e.g., those concerned with policy analysis, planning, management, budgeting, general counsel • Activities of numerous additional agencies or elements of agencies that participate in or comment upon Environmental Impact Statements prepared by the organizations listed on the chart above • Energy related basic research activities, such as that of the Energy Department, National Science Foundation, and Bureau of Standards (Commerce Department) • Agencies purchasing coal for their use, such as TVA and Department of Defense • Activities -- usually studies -- of the agencies of the Legislative Branch: <ul style="list-style-type: none"> • Library of Congress • Office of Technology Assessment (OTA) • General Accounting Office (GAO) • Congressional Budget Office (CBO) 			

Source: Developed from descriptions of various agency programs.

INTRODUCTION AND BACKGROUND

An important element of the NEP is the belief that coal must be the fuel which makes possible a reduction in the U.S. economy's energy related uses of oil and gas. The NEP sets goals for replacing oil and gas with coal and other energy alternatives. Meeting those goals will require increases in the production of coal, with the predicted added production ranging from 400 million more tons per year to 600 million more tons per year, or a possible doubling of 1977 annual production by 1985.

The President also stressed that projected increases in coal production can and must take place without increasing the damage caused by traditional coal mining and consumption practices. In his Environmental Message of May 23, 1977, the President said:

"The newly enacted Coal Leasing Amendments and the Federal Land Policy and Management Act provide the Secretary of the Interior with the necessary authority to carry out environmentally sound, comprehensive planning for the public lands. His duty now is to implement an affirmative program for managing coal lands and associated resources in a manner that fully protects the public interest and respects the rights of private surface owners" [18].

Following this message, the President, by memorandum of May 24, 1977, instructed the Secretary of the Interior to "manage the coal leasing program to assure that it can respond to reasonable production goals by leasing only those areas where mining is environmentally acceptable and compatible with other land uses."

The President further directed that the Department "scrutinize existing Federal coal leases (and applications for preference right leases) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications." The memorandum also contained the instruction to review the basis for granting or denying preference right leases and to propose legislation authorizing the Department to condemn outstanding leases upon payment of reasonable compensation, if necessary, to prevent unacceptable environmental damage. Implementation of these Presidential directives are addressed in subsequent chapters of this statement.

1.4.2 Congressional Action

Prior Congressional action in the coal management area was addressed previously in terms of major legislative proposals (see section 1.3). Recently, Congress has focused on the President's proposed National Energy Act.

The National Energy Act was submitted to Congress on April 29, 1977, in response to the President's April 20, 1977, message to a joint session of Congress. The Act was then divided into five major legislative initiatives to correspond to the jurisdictions of appropriate standing committees. On October 15, 1978, Congress passed five bills:

- The National Energy Conservation Act.
- The Power Plant and Industrial Fuel Use Act of 1978.
- The Public Utilities Regulatory Policy Act of 1978.
- The Natural Gas Policy Act of 1978.
- The Energy Tax Act of 1978.

Summaries of these Acts, as passed by Congress and signed by the President follow.

Conservation. The National Energy Conservation Policy Act contains incentives to reduce residential energy use. The Act provide grants for weatherizing lower income homes and a \$900 million 3-year grants program to states to improve the energy efficiency of schools, hospitals, and municipal buildings. Grants and government-backed loans are made available for low-income families. The Act also establishes mandatory efficiency standards for 13 major home appliances including water heaters and furnaces. These are to take effect in the mid-1980's. Finally, the Act establishes a program requiring utilities to inform their customers of suggested energy conservation and solar energy measures and to give loans to consumers to install conservation equipment. These measures could indirectly affect coal use by potentially reducing electrical demand from utilities.

Coal Conversion. The Power Plant and Industrial Fuel Use Act of 1978 would require use of coal or synthetic gas derived from coal or alternative fuels other than oil or natural gas in new utility generation facilities or in new industrial boilers, gas turbines, internal combustion, and combined cycle units with a capacity greater than 10 megawatts, unless exemptions are granted by DOE. For existing power plants and industrial facilities, DOE can require conversion to coal and other fuels or require use of coal-oil mixtures. An \$800 million loan program would assist companies to raise necessary funds for pollution control. Studies are mandated on competition issues, supply and demand problems, and socioeconomic considerations related to coal development.

Utility Rate Reform. The Public Utility Regulatory Policies Act of 1978 establishes several rate making standards to guide electric utility rate setting policies and practices. To the maximum extent practicable, rates charged by any electric utility should reflect the costs of providing that electric service and encourage conservation through time-of-day rates, seasonal rates, cost of service pricing, interruptible rates, lifeline rates and prohibition of declining block rates. State regulatory authorities and utilities would be required to formally consider standards within prescribed periods. The Act also requires the Federal Energy Regulatory Commission to prescribe rules favoring industrial cogeneration facilities.

Coal use could be affected by the Act through a leveling of electrical demand, thereby reducing the number of generating plants needed to supply peaking power.

Natural Gas. The Natural Gas Policy Act of 1978 is particularly significant in that it settles a 39-year confrontation between natural gas producers and consumers over the question of natural gas price controls. It provides continued controls through 1985 with appropriate safeguards beyond that period. The controlled, but escalating, price will substantially increase the incentives for new gas production. Most importantly, the Act will: (1) create a single national market for natural gas production; (2) increase production; and (3) increase producer revenues because of the ability of all producers to help satisfy the demand for natural gas in the interstate market. The 1 to 2 trillion cubic feet per year of

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extra gas that would flow into the interstate market would replace up to 1 million barrels per day of foreign oil imports.

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CHAPTER 2

THE NATIONAL ENERGY ROLE OF WESTERN AND FEDERAL COAL

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CHAPTER 2

THE NATIONAL ENERGY ROLE OF WESTERN AND FEDERAL COAL

2.1 INTRODUCTION

Fifty-four percent of the coal reserves in the United States are located west of the Mississippi River. Until recently, these reserves played only a limited role as a source of the Nation's coal production, largely because demand for coal was primarily in regions of the East and Midwest which have substantial coal reserves, and which satisfied their demand with coal produced from Appalachian and midwestern coal mines. In the past few years, however, production of western coal has increased rapidly, rising from 60 million tons in 1972 to 166 million tons in 1977 (24 percent of total 1977 coal production in the United States). This upward trend is expected to continue, as coal will make an increasingly important contribution to the Nation's energy supplies, especially for electric power generation, and as demand for coal increases in the western states.

Federally owned coal is concentrated in the six key western coal producing states of Colorado, Montana, New Mexico, North Dakota, Utah and Wyoming, which in 1977 together accounted for 71 percent of the production of all western coal. Production of Federal coal in these states was 51.7 million tons in 1977, or 43.7 percent of their total coal production and 7.5 percent of national coal production [18].

Federal coal is expected to have a growing importance in national coal production. Of overall western coal reserves, approximately 60 percent is owned by the Federal Government and an additional 20 percent is dependent on the availability of complementary Federal coal for its production.

2.2 COAL RESERVES AND CHARACTERISTICS

In describing the production potential of coal, it is customary to distinguish between coal "resources" and "reserves." The term "resource" describes the estimated total amount of coal for which economic extraction could eventually become feasible. The coal "reserve" is that limited portion of the resource which is judged to be minable at a profit under existing market conditions [19]. The total identified coal resource of the United States is estimated to be 1.7 trillion tons [3]. Of this coal only 438 billion tons have thus far been identified with enough certainty and with sufficient economic prospects to be included in the reserve category.

Reserve calculations for western coal are based in many cases on old geologic data and are probably considerably underestimated. The United States Geological Survey has underway a coal exploration program which will generate improved reserve estimates over the next few years.

For this programmatic environmental impact statement, twelve coal regions were selected as basic units for analysis, as shown in Figure 1-1. The twelve regions contain over 92

percent of the reserve base of the United States and account for over 97 percent of current U.S. coal production.

The regions shown in Figure 1-1 are used throughout this impact statement as the geographic basis for identifying coal production levels and subsequent impacts. The regions were delineated based on similarities of coal characteristics (as shown on the 1960 USGS map of coal fields of the U.S. [1]) and on opportunities for and the likelihood of new or expanded coal production, both from Federal and non-Federal sources. Each region has somewhat similar climatic, transportation, topographic and vegetative characteristics.

As discussed further below, the Federal Government administers large amounts of coal in the Fort Union, Powder River, Green River-Hams Fork, Uinta-Southwestern Utah, San Juan River, and Denver-Raton Mesa Coal Regions. Minor amounts of Federal coal are located in the southern portions of the Western Interior and Southern Appalachian Coal Regions. It is within these geographic areas that the preferred Federal coal management program, described in Chapter 3, would function.

Within the Northern and Central Appalachian, Eastern Interior and Texas Coal Regions, the Federal Government owns essentially no coal. These regions are included in order to fully present the impacts of Federal coal management actions which might cause coal production to shift from regions with significant Federal coal ownership to regions with high production potential of predominantly non-Federal coal.

Certain areas of the nation with coal, principally eastern Pennsylvania, southern Michigan, central Texas, northern Montana, Arizona, Washington and Alaska, are not included in any of the twelve coal regions. Several of the areas – such as eastern Pennsylvania, Washington and Alaska – were isolated from other regions and did not have enough expected coal production by themselves to form a separate region. Other areas – such as central Michigan and central Texas – are not expected to have any significant production in the near future. The San Juan River Coal Region does not include the State of Arizona because it has little Federal coal, and yet Arizona did not have enough projected production to be a separate region.

Table 2-1 shows the estimated coal reserve base and 1976 production for each of the twelve coal regions. Of the total reserves in the West, a large proportion (66 percent) are located in the Powder River Coal Region. The next most important western coal regions are the Fort Union (11 percent of western coal reserves), Western Interior (7 percent), and Green River-Hams Fork (7 percent) Coal Regions. In the East, reserves are divided almost equally between the Appalachian (54 percent) and the Eastern Interior (46 percent) Coal Regions.

The proportion of surface minable coal reserves in the West is significantly larger than for the Nation as a whole. Seventy-four percent (by weight) of the surface minable

TABLE 2-1

REGIONAL AND U.S. COAL RESERVE BASE AND PRODUCTION LEVEL ^(a)

COAL REGION	RESERVE BASE ^(b) (millions of tons)			PRODUCTION ^(a) 1976 (thousands of tons)		
	DEEP	SURFACE	TOTAL	DEEP	SURFACE	TOTAL
Appalachian						
Northern	59,266	6,292	65,558	92,028	83,931	175,959
Central	27,321	7,589	34,910	125,928	80,889	206,817
Southern	1,963	250	2,213	8,605	14,783	23,388
Subtotal	88,550	14,131	102,681	226,561	179,603	406,164
Eastern Interior	71,110	17,801	88,911	55,366	81,075	136,441
Western Interior	10,125	5,467	15,592	339	11,111	11,450
Texas	0	3,271	3,271	0	14,063	14,063
Powder River	86,500	56,024	142,524	119	37,290	37,409
Green River-Hams Fork	13,396	2,147	15,543	768	24,916	25,684
Fort Union	0	23,101	23,101	0	11,414	11,414
San Juan River	1,906	2,258	4,164	17	8,824	8,841
Uinta-Southwestern Utah	5,656	308	5,964	10,144	0	10,144
Denver-Raton Mesa	3,865	0	3,865	1,453	409	1,862
Total of 12 Regions	281,108	124,508	405,616	294,767	368,705	663,472
U.S. Total ^(c)	296,976	141,361	438,337	294,771	383,914	678,685
Regions as Percent of U.S.	94.7	88.3	92.6	100	96.0	97.8

(a) Source: Reference Number 2

(b) Source: Reference Number 3

(c) Alaska coals and anthracite coals not included.

reserves shown in Table 2-1 are located west of the Mississippi River. Western surface minable reserves in many cases have less overburden and lie in thicker beds by eastern standards. This generally results in relatively lower mining costs, although these lower costs historically were not enough to compensate for higher transportation costs to eastern coal markets. The Powder River Coal Region in northeast Wyoming and southeast Montana contains 40 percent of the United States' surface minable reserves, and has an exceptionally high average seam thickness of 25 feet (eastern seams are typically 4-8 feet thick). Another western region, the Fort Union Coal Region, contains 16 percent of the national reserves of surface minable coal, although it is largely comprised of less valuable lignite.

Surface mining of coal has increased steadily as a proportion of national production. In the nineteenth century, all mining was by underground methods. However, by 1950 surface mining in the United States was 24 percent of overall production and, by 1976, it was 56 percent.

There are substantial variations in the heating value (Btus) of a unit of coal [20]. Eastern coal is almost entirely bituminous coal (94 percent) and anthracite, and has a higher heat content than most western coal. Of total western coal, 75 percent is subbituminous and 15 percent lignite, and only 10 percent is the more desirable bituminous. Although western coal reserves represent 54 percent of the nation's reserves by weight, on a Btu basis they represent only around 45 percent of total national reserves. The overall distribution of coal types by State is shown in Table 2-2.

Sulfur content is a key factor in assessing the value of coal. The sulfur content of coal in the United States generally ranges from 0.2 to 7.0 percent by weight. The presence of sulfur lowers the quality of coke and the resulting iron and steel products. Sulfur also contributes to corrosion and to the formation of boiler deposits. Sulfur compounds may react with water to form sulfuric acid, which is one of the major deleterious substances in acid mine waters contributing to stream pollution. Most importantly, sulfur compounds are a major source of air pollution, particularly in the form of sulfur dioxide.

The percentage of sulfur is highest in the Appalachian and Eastern Interior Coal Regions. Western Interior Coal Region coals are also relatively high in sulfur content. The sulfur percentage is relatively low in the subbituminous coals and lignite of the western states which contain large Federal coal reserves. Because of the varying heating (Btu) values of coal, a given sulfur percentage by weight involves varying sulfur content by energy provided. Western coal is also typically low in sulfur content per Btu, although less so than the sulfur percentage by weight would suggest.

Generally, coal with less than 1 percent sulfur by weight is considered "low sulfur" coal. Only 16 percent of eastern coal is considered low sulfur, compared with 71 percent of western coal (see Tables 2-3 and 2-4). Eighty-four percent of the Nation's low sulfur coal is located in the West. On a tonnage basis, there are nevertheless substantial low sulfur reserves in the East, much of it metallurgical coal.

Within the six western states with major Federal coal ownership, coal mining will be concentrated in areas which are identified by the U.S. Geological Survey as Known Recoverable Coal Resource Areas (KRCRAs) (see Figure 2-

1). The total area included within the KRCRAs defined as of March 1978 was 17.4 million acres (see Table 2-5). It is expected that about 25 million acres will be included in KRCRAs when mapping is completed. Around half of this acreage is expected to have coal of medium or high development potential. By comparison, the total land area of the six western Federal coal states is 396 million acres.

The distribution of coal ownership within KRCRAs is shown in Table 2-5. In many cases, surface ownership differs from subsurface ownership. The largest single ownership category is private surface and Federal coal, which includes 35 percent of the total KRCRA acreage. The second largest category is private surface and non-Federal (usually private) coal, covering 27 percent of the total acreage. Public domain surface with Federal coal and Forest Service surface with Federal coal cover 22 percent and 5 percent of total KRCRA acreage, respectively. Finally, state surface and non-Federal (usually state) coal has 5 percent of the acreage.

Of the total KRCRA acreage, 70 percent of the surface is non-Federally owned. Only 44 percent of the total Federal coal acreage has Federal surface ownership as well. Federal subsurface ownership of the coal, on the other hand, covers 66 percent of the total KRCRA acreage. Mainly because the Federal ownership share is unusually high (80 percent) in the Powder River Coal Region, where coal seams are exceptionally thick and contain large amounts of coal per acre, total Federal coal reserves are estimated to be 72 percent of total KRCRA reserves.

2.3 HISTORY OF NATIONAL COAL USE

Coal is the primary energy source upon which the Nation's early industrial and economic growth was based. Basic industries such as railroads, steel, and, later, electric power generation were developed and rapidly expanded through the production and use of coal. The coal industry reached a 100-million ton level of production by 1880 and 212 million tons by 1900. Stimulated by World War I, coal production reached 579 million tons in 1918. Coal production declined after the war (particularly during the Depression), reaching a low in 1932 of 310 million tons. With World War II, production again rose to new heights, reaching a peak in 1947 of 631 million tons [21].

Once again, however, the coal industry went into decline and reached its post-war low of 392 million tons in 1954. For the next 10 years, while major year-to-year fluctuations sometimes occurred, the basic level of coal use increased only slightly. But by the mid-1960's, the industry had begun an upward trend that by 1977 had reached an annual production level of 689 million tons, the highest ever.

For many years the major coal use categories were railroads, manufacturing and mining industries, retail dealer deliveries, coke plants, and electric utilities. In 1944, railroads consumed 132 million tons of coal. The introduction of diesel locomotives and electrification, however, caused the railroad market for coal to virtually disappear by the early 1960's. Also, the use of coal by ships has been displaced almost entirely by oil. Retail coal deliveries for space heating declined steadily over the years, from more than 122 million tons in 1944 to 7 million tons in 1977.

TABLE 2-2

DEMONSTRATED RESERVE BASE^(a) OF COALS IN THE UNITED STATES ON JANUARY 1, 1976
POTENTIALLY MINABLE BY UNDERGROUND AND SURFACE METHODS^(b)
(million short tons)

STATE	ANTHRACITE		BITUMINOUS		SUBBITUMINOUS		LIGNITE		UNDER TOTAL	SURFACE TOTAL	STATE TOTAL
	UNDER.	SURFACE	UNDER.	SURFACE	UNDER.	SURFACE	UNDER.	SURFACE			
Alabama	-	-	1,724.2	284.4	-	-	-	1,083.0	1,724.2	1,367.4	3,091.6
*Alaska	-	-	617.0	80.5	4,805.9	640.7	-	14.0	5,422.9	735.2	6,158.1
*Arizona	-	-	-	325.5	-	-	-	-	-	325.5	325.5
Arkansas	88.6	7.8	163.1	107.0	-	-	-	25.7	251.7	140.5	392.2
*Colorado	25.5	-	8,467.9	676.2	3,972.1	149.2	-	2,965.7	12,465.5	3,791.1	16,256.6
Georgia	-	-	0.5	0.4	-	-	-	-	0.5	0.4	0.9
Idaho	-	-	4.4	-	-	-	-	-	4.4	-	4.4
Illinois	-	-	53,128.1	14,841.2	-	-	-	-	53,128.1	12,841.2	67,969.3
Indiana	-	-	8,939.8	1,774.5	-	-	-	-	8,939.8	1,774.5	10,714.3
Iowa	-	-	1,736.8	465.4	-	-	-	-	1,736.8	465.4	2,202.2
Kansas	-	-	-	998.2	-	-	-	-	-	998.2	998.2
Kentucky, East	-	-	9,072.5	4,467.6	-	-	-	-	9,072.5	4,467.6	13,540.1
Kentucky, West	-	-	8,510.4	3,950.4	-	-	-	-	8,510.4	3,950.4	12,460.8
Louisiana	-	-	-	-	-	-	-	(c)	-	(c)	(c)
Maryland	-	-	913.8	134.5	-	-	-	-	913.8	134.5	1,048.3
Michigan	-	-	125.2	1.6	-	-	-	-	125.2	1.6	126.8
Missouri	-	-	1,418.0	3,596.0	-	-	-	-	1,418.0	3,596.0	5,014.0
*Montana	-	-	1,385.4	-	69,573.5	33,843.2	-	15,766.8	70,958.9	49,610.1	120,569.0
*New Mexico	2.3	-	1,258.8	601.1	889.0	1,846.8	-	-	2,150.1	2,447.9	4,598.0
North Carolina	-	-	31.3	0.4	-	-	-	-	31.3	0.4	31.7
*North Dakota	-	-	-	-	-	-	-	10,145.3	-	10,145.3	10,145.3
Ohio	-	-	13,090.5	6,139.8	-	-	-	-	13,090.5	6,139.8	19,230.3
Oklahoma	-	-	1,192.9	425.2	-	-	-	-	1,192.9	425.2	1,618.1
*Oregon	-	-	(c)	-	14.5	2.9	-	-	14.5	2.9	17.4
Pennsylvania	6,966.8	142.7	22,335.9	1,391.8	-	-	-	-	29,302.7	1,534.5	30,837.2
*South Dakota	-	-	-	-	-	-	-	426.1	-	426.1	426.1
Tennessee	-	-	627.2	337.9	-	-	-	-	627.2	337.9	965.1
Texas	-	-	-	-	-	-	-	3,181.9	-	3,181.9	3,181.9
*Utah	-	-	6,283.8	267.9	1.1	-	-	-	6,284.9	267.9	6,552.8
Virginia	137.5	-	3,277.0	888.5	-	-	-	-	3,414.5	888.5	4,303.0
*Washington	-	-	255.3	-	835.3	481.5	-	-	1,090.6	489.6	1,580.2
West Virginia	-	-	33,457.4	5,149.1	-	-	-	-	33,457.4	5,149.1	38,606.5
*Wyoming	-	-	4,002.5	-	27,644.8	23,724.7	-	-	31,647.3	23,724.7	55,372.0
Subtotal Western States	27.8	-	22,275.1	1,951.2	107,736.2	60,689.0	-	29,326.0	130,039.1	91,966.3	222,005.4
Subtotal Eastern States	7,192.9	150.5	159,744.6	44,953.9	-	-	-	4,290.6	166,937.5	49,395.0	216,005.4
TOTAL	7,220.7	150.5	182,019.7	46,905.1	107,736.2	60,689.0	-	33,616.6	296,976.6	141,361.3	438,337.9

Source: Reference Number 3.

(a) Includes measured and indicated resource categories as defined by the USBM and USGS and represents 100% of the coal in place.

(b) Figures have been rounded.

(c) Quantity undetermined (basic resource data do not provide the detail required for delineation of reserve base).

*Western states including Alaska

TABLE 2-3

THE DEMONSTRATED RESERVE BASE OF COALS OF THE WESTERN UNITED STATES

ON JANUARY 1, 1974, BY MINING METHOD AND SULFUR CONTENT

(million tons)

STATE	MINING METHOD	SULFUR CONTENT, WEIGHT-PERCENT				TOTAL
		<1.0	1.1-3.0	>3.0	UNKNOWN	
Alaska	Deep	4,080.8	163.2	0	0	4,246.4
	Surface	7,377.8	21.0	0	0	7,399.0
Arizona	Surface	173.2	176.7	0	0	350.0
Arkansas	Deep	43.4	310.3	29.2	19.1	402.4
	Surface	37.9	152.9	17.1	55.2	263.3
Colorado	Deep	6,751.3	640.0	47.3	6,547.4	13,999.2
	Surface	724.2	146.2	0	0	870.0
Iowa	Deep	1.6	226.7	2,105.9	549.2	2,884.9
Kansas	Surface	0	309.3	695.6	383.2	1,388.1
Missouri	Deep	0	134.2	3,590.2	2,350.5	6,073.6
	Surface	0	47.8	1,635.8	1,730.0	3,413.7
Montana	Deep	63,464.4	1,939.9	456.2	0	65,834.3
	Surface	38,182.5	2,175.4	46.4	2,166.7	42,562.0
New Mexico	Deep	1,894.4	214.1	0.8	27.5	2,136.5
	Surface	1,681.1	579.4	0	0	2,258.3
North Dakota	Surface	5,389.0	10,325.5	268.7	15.0	16,003.0
Oklahoma	Deep	154.5	238.4	202.6	264.3	860.1
	Surface	120.5	88.2	38.8	186.2	434.1
Oregon	Deep	1.0	0	0	0	1.0
	Surface	0.5	0.3	0	0	0.9
South Dakota	Surface	103.1	287.9	35.9	1.0	428.0
Texas	Surface	659.8	1,884.7	284.1	444.0	3,271.9
Utah	Deep	1,916.2	1,397.6	6.8	460.3	3,780.5
	Surface	52.3	149.2	42.6	18.0	262.0
Washington	Deep	431.0	957.7	13.2	42.9	1,445.9
	Surface	172.5	307.7	25.8	2.2	508.1
Wyoming	Deep	20,719.1	4,535.0	1,275.6	2,955.0	29,489.8
	Surface	13,192.9	10,122.4	425.5	105.3	23,845.3
Total (a)	Deep	99,457.7	10,757.2	7,727.8	13,216.2	131,155.6
	Surface	67,866.8	26,774.3	3,516.3	5,106.8	103,256.8
Grand Total		167,324.5	37,531.5	11,244.1	18,323.0	234,412.4

(a) Distribution may not add to total because of the rounding of individual figures.

SOURCE: Reference Number 5.

TABLE 2-4

THE DEMONSTRATED RESERVE BASE OF COALS OF THE
EASTERN UNITED STATES ON JANUARY 1, 1974,
BY MINING METHOD AND SULFUR CONTENT
(million tons)

STATE	MINING METHOD	SULFUR CONTENT, WEIGHT-PERCENT				
		<1.0	1.1-3.0	> 3.0	Unknown	Total
Alabama	Deep	589.3	1,106.7	14.8	176.2	1,887.0
	Surface	35.4	83.2	1.6	1,063.2	1,183.4
Georgia	Deep	0.3	0	0	0.2	0.5
	Surface	0	0	0	(b)	0
Illinois	Deep	1,034.7	5,848.4	33,647.6	12,908.4	53,439.1
	Surface	60.4	1,493.0	9,321.3	1,347.8	12,222.5
Indiana	Deep	443.5	2,746.6	4,355.1	1,402.5	8,947.7
	Surface	105.3	559.2	907.3	101.6	1,673.4
Kentucky, East	Deep	5,042.7	2,391.9	212.7	1,814.0	9,461.3
	Surface	1,515.7	929.9	86.8	915.3	3,447.7
Kentucky, West	Deep	0	386.0	7,226.4	1,107.1	8,719.5
	Surface	0.2	177.8	2,017.5	1,708.8	3,904.3
Maryland	Deep	106.5	623.9	171.2	-	901.6
	Surface	28.6	66.6	16.2	34.6	146.0
Michigan	Deep	4.6	84.9	20.8	7.0	117.3
	Surface	-	0.5	0.1	-	0.6
North Carolina	Deep	-	-	-	31.3	31.3
	Surface	-	-	-	0.4	0.4
Ohio	Deep	115.5	5,449.9	10,109.4	1,754.1	17,428.9
	Surface	18.9	991.0	2,524.9	117.9	3,652.7
Pennsylvania	Deep	7,179.7	16,195.2	3,568.1	2,864.8	29,807.8
	Surface	138.6	718.4	231.5	89.5	1,178.0
Tennessee	Deep	139.3	370.0	101.4	53.9	664.6
	Surface	65.5	163.2	55.2	34.1	318.0
Virginia	Deep	1,728.5	945.4	12.0	238.3	2,969.2
	Surface	411.6	218.1	2.1	46.7	678.5
West Virginia	Deep	11,086.6	12,583.4	6,552.9	4,142.9	34,365.8
	Surface	3,005.5	1,422.8	270.4	509.6	5,208.0
TOTAL	Deep	27,471.2	48,732.3	65,992.4	26,545.7	168,741.6
	Surface	5,385.7	6,823.7	15,434.9	5,969.5	33,613.8
GRAND TOTAL ^(a)		32,856.9	55,556.0	81,427.3	32,515.2	202,355.4

(a) Distribution may not add to total because of the rounding of individual figures.

(b) Undetermined.

Source: Reference Number 5.



FIGURE 2-1
KNOWN RECOVERABLE COAL RESOURCE AREAS
(KRCRA s)

TABLE 2-5
KRCRA COAL AND SURFACE OWNERSHIP^(a)
(Acres)

REGION AND KRCRA	PUBLIC DOMAIN SURFACE FEDERAL COAL(b)	PUBLIC DOMAIN SURFACE NONFEDERAL COAL	PRIVATE SURFACE FEDERAL COAL	PRIVATE SURFACE NONFEDERAL COAL	STATE SURFACE FEDERAL COAL	STATE SURFACE NONFEDERAL COAL	FOREST SERVICE SURFACE FEDERAL COAL	FOREST SERVICE SURFACE NONFEDERAL COAL	OTHER SURFACE FEDERAL COAL(c)	OTHER SURFACE NONFEDERAL COAL	GRAND TOTAL
Fort Union Region											
North Dakota KRCRAs											
Bowman-Gascoyne			74,910	131,680	2,120	2,240	2,890		50,730	18,990	283,560
Dickinson			80,440	310,520	320	2,240			4,440	1,000	398,960
Knife River	640		322,600	802,890	600	27,960			3,740	4,610	1,163,040
New England-Mott	40		186,970	346,680	160	9,040			20,650	1,280	564,820
Niobe			880	15,040		120					16,040
Velva			3,200	17,600		120					20,920
Williston-Avoca	120		42,160	18,840	440	2,880			300	290	65,030
Total	800	0	711,160	1,643,250	3,640	44,600	2,890	0	79,860	26,170	2,512,370
Montana KRCRAs											
Burns Creek-13 Mile Creek	400	320	98,640	120,480	3,440	15,360					238,640
Circle	5,680		181,240	225,760	3,360	25,160					441,200
Knowlton	120	1,460	1,840	8,280		1,680			6,000	760	20,140
Lame Jones Creek	1,640		6,320	25,320		3,240			5,720	520	42,760
Pine Hills	1,040		6,200	10,120		600					17,960
Sidney	17,800	480	103,660	159,660	3,800	18,160					303,560
Wibaux Beach	4,200		96,680	70,600	80	2,280					173,840
Total	30,880	2,260	494,580	620,220	10,680	66,480	0	0	11,720	1,280	1,238,100
Fort Union Total	31,680	2,260	1,205,740	2,263,470	14,320	111,080	2,890	0	91,580	27,450	3,750,470
Powder River Region											
Montana KRCRAs											
Powder River Basin	193,430	60	1,046,895	443,560	21,190	107,980	434,515	3,120	2,470	2,960	2,256,180
Wyoming KRCRAs											
Powder River Basin	390,901	1,831	2,767,827	276,606	24,418	365,119	55,986	5,040	68,367	29,243	3,985,338
Powder River Total	584,331	1,891	3,814,722	720,166	45,608	473,099	490,501	8,160	70,827	32,203	6,241,518
Green River-Hams Fork Region											
Wyoming KRCRAs											
Hanna-Carbon Basin	85,493	160	6,454	116,367	760	7,343			6,649		223,226
Kemmerer	105,260		18,053	125,751	1,163	14,004			2,331		266,562
Rawlins	49,863	40	16,155	48,761	480	5,280	160		3,050	40	123,829
Red Desert	453,267	640	7,834	309,076	80	12,040			880		783,817
Rock Springs	430,487	120	7,739	312,905	249	18,467			4,973		774,940
Total	1,124,370	960	56,235	912,860	2,732	57,134	160	0	17,883	40	2,172,374
Colorado KRCRAs											
McCallum	18,400	240	5,040	15,120	2,640	4,640			800		46,880
Yampa	36,970	3,640	269,300	101,675	640	40,990	2,060	640	10,965	120	467,000
Total	55,370	3,880	274,340	116,795	3,280	45,630	2,060	640	11,765	120	513,880
Green River-Hams Fork											
Total	1,179,740	4,840	330,575	1,029,655	6,012	102,764	2,220	640	29,648	160	2,686,254
UintaSouthwestern Utah Region											
Utah KRCRAs											
Alton-Kanab	48,040	1,160	27,380	11,450	280	2,680	25,040				116,030
Book Cliffs	42,440	280	39,540	38,960	1,600	6,560					129,380
Henry Mountains	34,540			40		5,480			400		40,460
Kaiparowits Plateau	397,760	2,520	1,780	1,160	80	46,320	71,600	200	10,760	400	532,580
Wasatch Plateau	12,120		36,640	47,320	2,720	5,360	192,650	840			297,650
Total	534,900	3,960	105,340	98,930	4,680	66,400	289,290	1,040	11,160	400	1,116,100

- (a) Includes Known Recoverable Coal Resource Areas (KRCRAs) defined as of March 1978.
(b) Includes BLM administered lands
(c) Includes Bankhead-Jones acquired lands, Federal withdrawn lands, and Indian lands.

TABLE 2-5
(Concluded)
KRCRA COAL AND SURFACE OWNERSHIP^(a)
(Acres)

REGION AND KRCRA	PUBLIC DOMAIN SURFACE FEDERAL COAL(b)	PUBLIC DOMAIN SURFACE NONFEDERAL COAL	PRIVATE SURFACE FEDERAL COAL	PRIVATE SURFACE NONFEDERAL COAL	STATE SURFACE FEDERAL COAL	STATE SURFACE NONFEDERAL COAL	FOREST SERVICE SURFACE FEDERAL COAL	FOREST SERVICE SURFACE NONFEDERAL COAL	OTHER SURFACE FEDERAL COAL(c)	OTHER SURFACE NONFEDERAL COAL	GRAND TOTAL
Uinta-SW Utah (Continued)											
Colorado KRCRAs											
Danforth Hills	46,850	2,560	101,230	16,970		4,350			640		172,600
Lower White River	152,320	40	13,200	4,700		3,840			2,920		177,020
Paonia-Somerset	31,560	80	65,640	22,690			94,980		600		213,550
Total	230,730	2,680	180,070	44,360	0	8,190	94,980	0	4,160	0	565,170
Uinta Total	765,630	6,640	285,410	143,290	4,680	74,590	384,270	1,040	15,320	400	1,681,270
San Juan River Region											
New Mexico KRCRAs											
La Ventana	172,840	3,420	39,380	8,200	4,960	16,240			58,000	22,800	325,840
San Juan	1,007,140	23,500	165,200	89,940	19,320	115,960	7,040		331,980	75,280	1,835,360
Tsaya	5,320		40	240		6,200			39,420	34,300	85,520
Total	1,185,300	26,920	204,620	98,380	24,280	138,400	7,040	0	429,400	132,380	2,246,720
Colorado KRCRAs											
Cimarron Ridge	3,120		10,400	4,920			2,000		80		20,520
Durango	27,750	120	58,150	70,680	2,910	20,780	53,610	3,140	480	1,120	238,740
East Cortez	1,720		400	6,160		1,440					9,720
Nucla	1,880			3,080					120		5,080
Total	34,470	120	68,950	84,840	2,910	22,220	55,610	3,140	680	1,120	274,060
San Juan River Total	1,219,770	27,040	273,570	183,220	27,190	160,620	62,650	3,140	430,080	133,500	2,520,780
Denver-Raton Mesa Region											
Colorado KRCRAs											
Denver Basin			94,800	348,980	1,200	28,560			640		474,180
Denver-Raton Mesa Total	0	0	94,800	348,980	1,200	28,560	0	0	640	0	474,180
GRAND TOTAL - ALL REGIONS	3,781,151	42,671	6,004,817	4,688,781	99,010	950,713	942,531	12,980	638,105	193,713	17,354,472

Source: Reference Number 4.

Coal used for coke plants, which was 107 million tons in 1955, had fallen to 77 million tons by 1977. The gradual decline in this use resulted from technological changes in the coking processes, including increased injection of supplemental fuels and modification of blast furnace practices. Nevertheless, it is expected that the demand for coking coal will be reasonably steady over the near term, with relatively small further declines resulting from technological changes.

Industrial uses, other than electric power generation, include coal used for general manufacturing and mining and for cement, steel, and rolling mills. Industrial coal consumption has declined from approximately 270 million tons in 1945 to 60 million tons in 1977.

As recently as 1943, coal contributed more than 50 percent of the Nation's total energy. By 1977, it contributed only 18 percent. Except for coke ovens, the declines in the U.S. domestic coal markets following World War II resulted primarily from the rapid takeover of these markets by oil and natural gas. These fuels were cheap, easy to handle, and relatively clean, and thus provided a competition that coal was unable to meet. Table 2-6 shows the historical pattern of decline of coal in these markets.

Compensating considerably for the loss or decline of all but one of its historical markets, and its exclusion from new markets by the rise of oil and gas consumption, has been the rapid growth in the use of coal for electric power generation. As recently as 1950, less than 100 million tons of coal were used by utilities. By 1977, use of coal for electric power generation reached 475 million tons and is expected to constitute the major source of future increases in coal use.

The growth since World War II of coal exports has provided additional coal markets, particularly for coals of metallurgical quality. In 1957, during the Suez Crisis, exports reached more than 76 million tons. In recent years, exports generally have been in the mid-50 million ton level, but rose to over 65 million tons in 1975.

2.4 THE GROWTH IN WESTERN AND FEDERAL COAL PRODUCTION

Before 1972, coal production in the six western Federal coal States (Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming) never exceeded 40 million tons or 7 percent of national production. In 1962, these States produced only 14 million tons, or 3.3 percent of national coal production. As seen in Figure 2-2, production from all western coal regions was still far lower in 1976 than their proportionate share of the Nation's coal reserves.

Production of Federal coal has been even more minimal. Although in the six western Federal coal States more than 70 percent of the coal is Federally owned, in 1972 production of Federal coal totaled only 9 million tons or 20 percent of the six states' total production.

This situation has been changing rapidly. Total western production - including that of Texas, Arizona, and the Western Interior Coal Region, - reached 165.4 million tons, or 24 percent of national production in 1977 (see Table 2-8a). Coal production from the six western Federal coal states was 118.4 million tons in 1977, up from 39.3 million tons in 1971 (see Table 2-7). Production of Federal coal has also been

rising rapidly. In 1977, Federal coal production in the six states rose to 51.9 million tons, a five-fold increase over 1971.

As seen in Table 2-8, Wyoming was the leading Federal coal producing State as of 1977. Production of Federal coal in Wyoming grew from only 5 million tons in 1973 to 28.3 million tons in 1977. Federal coal production in Montana has also grown rapidly, from 1.9 million tons in 1973 to 10.5 million tons in 1977. Almost all the recent growth in Federal coal production in Montana and a large share of it in Wyoming has been from the Powder River Coal Region.

The increasing production of western and Federal coal is attributable to two key factors. The most important is the sharp rise in the price of oil and natural gas, which has made these fuels uneconomical to use in new utility boilers. Many new western power plants are coal burning, and are using coal mined in the West. In addition, some western plants now burning oil or gas are converting to coal, and this coal is obtained from the western regions.

In the East, there is much greater traditional use of coal for power generation. Because transportation is a substantial portion of the overall cost of coal, eastern power plants traditionally used eastern coal. The economics of eastern power generation were significantly altered, however, by air quality control regulations under the 1970 Clean Air Act Amendments, particularly with respect to sulfur dioxide emissions. Emission standards were set for new plants which were low enough to prohibit use of most eastern coal unless utilities invested in pollution control equipment, but high enough to permit most western coal, which is lower in sulfur content, to be burned without the installation of control equipment [5]. For many eastern and mid-western utilities, the added cost of building a scrubber was large enough that they preferred to substitute western coal even if its energy content was lower and transportation costs were relatively high. Greater ease of passing through to customers increased fuel costs may also have played a part in this utility preference.

Changes in the emission standards for new power plants are required by the 1977 Clean Air Act Amendments. These new standards are expected to greatly reduce the amount of sulfur which can legally be emitted into the air. Most western coal, like most coal from the East and Midwest, contains enough sulfur to require that coal-burning power plants use pollution control equipment to meet the expected new standards. The stricter air quality standards will diminish the economic advantage of western coal over eastern and midwestern coal, and will result in power companies in the East and Midwest using more coal from their own regions instead of transporting coal from the West. However, since power plants coming on line until 1983 will largely be using the old standard, it will be some time before the new standard affects western production. Overall demand for western coal will not be greatly affected by the new air quality standards, because most new demand for western coal will be from power plants and industries in the West. The growth in coal demand is expected to be higher in the West than in any other region of the country.

Western coal is used mainly for electric power generation, with small amounts used for metallurgical and other purposes. The use of western coal by consumer classification is shown in Table 2-9.

TABLE 2-6

CONSUMPTION AND EXPORTS OF BITUMINOUS COAL AND LIGNITE
BY CONSUMER CLASS IN SELECTED YEARS 1933-1977 (a)
(thousand short tons)

YEAR	ELECTRIC POWER UTILITIES	COKE PLANTS	STEEL AND ROLLING MILLS	RAIL- ROADS CLASS II	MANU- FACTURING AND MINING(c)	TOTAL INDUS- TRIAL	RETAIL DEALER DELIVERIES	BUNKER FOREIGN & LAKE VESSEL	TOTAL U.S.	EXPORTS	GRAND TOTAL(b)
1933	27,088	40,089	14,129	72,548	84,137	170,814	77,396	2,298	317,685	9,037	326,722
1935	30,936	50,515	16,585	77,109	98,054	191,748	80,444	2,683	356,326	9,742	366,068
1940	49,126	81,386	14,169	85,130	113,423	212,722	84,687	2,989	430,910	16,466	447,376
1945	71,603	95,349	14,241	125,120	130,765	270,096	119,297	3,192	559,567	27,956	587,523
1947	86,009	104,800	14,195	109,296	131,847	255,338	96,657	3,087	545,891	68,667	614,558
1950	88,262	103,845	10,877	60,969	103,785	175,631	84,422	2,042	454,202	25,468	479,670
1955	140,550	107,377	7,353	15,473	98,140	120,966	53,020	1,499	423,412	51,277	474,689
1960	173,882	81,015	7,378	2,101	84,703	94,182	30,405	945	380,429	36,541	416,970
1965	242,729	94,779	7,466	-	94,487(c)	101,953	19,048	655	459,164	50,181	509,345
1970	318,921	96,009	5,410	-	82,909	888,319	12,072	298	515,619	70,944	586,563
1973	386,879	93,634	6,356	-	60,837	67,193	8,200	116	556,022	52,870	608,892
1975	403,249	83,272	2,715	-	59,759	62,474	7,282	24	556,301	65,669	621,970
1976	447,021	84,324	2,743	-	57,750	60,493	6,900	12	598,750	59,406	678,685
1977	474,818	77,380	3,243	-	57,146	60,389	7,020	9	619,616	53,687	673,303

(a) Sources: Reference Numbers 6 and 7.

(b) Differences between the total of consumption plus exports and total production accounted for principally by coal in transit between mines and consumer facilities and coal put into stockpiles.

(c) Includes cement mills, all years, and railroad fuel after 1960.

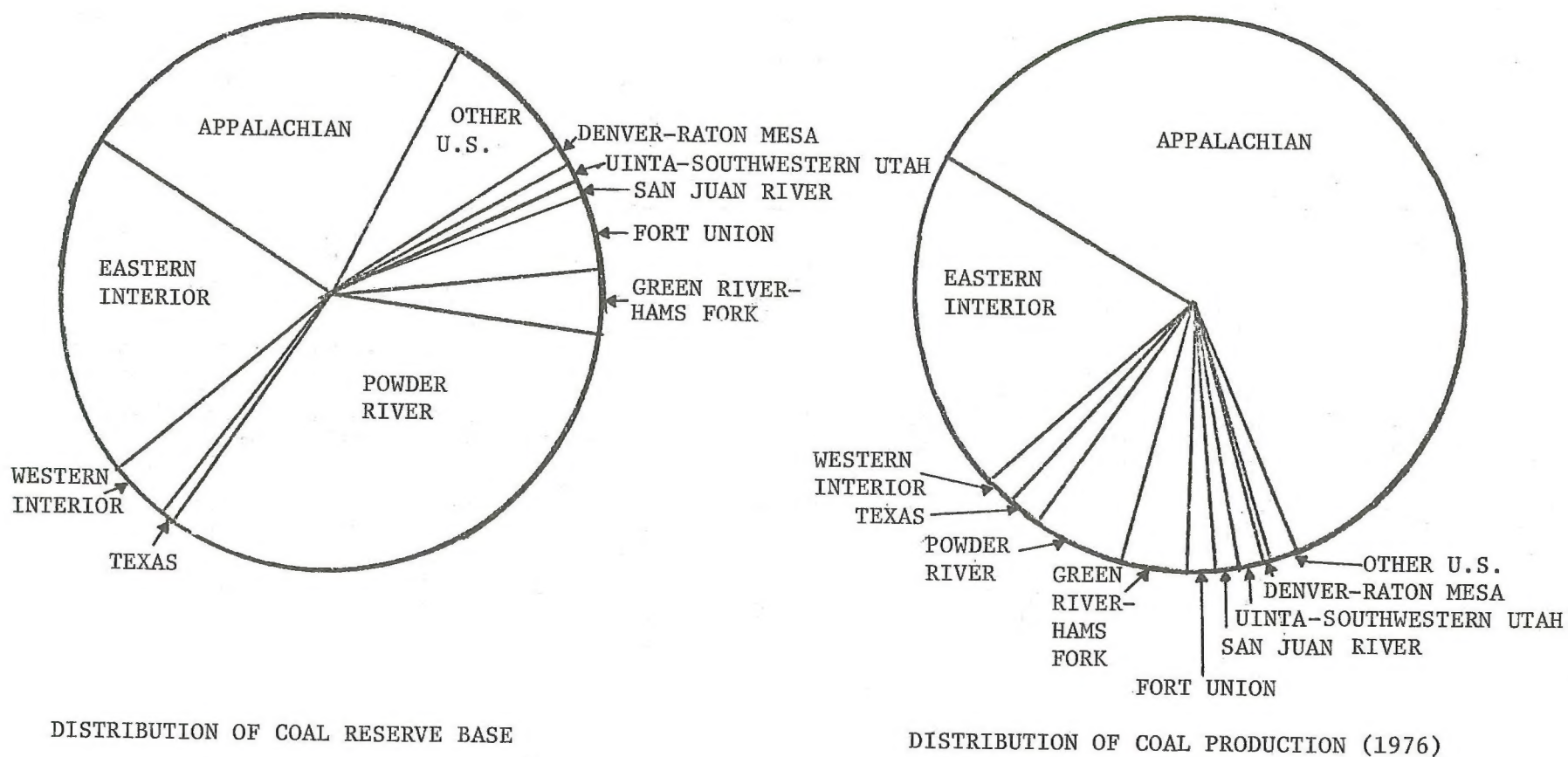


FIGURE 2-2
DISTRIBUTION OF THE COAL RESERVE BASE AND OF 1976 PRODUCTION
(EXCLUDES ALASKAN COAL)

Source: Table 2-1.

TABLE 2-7

COAL PRODUCTION FROM FEDERAL LANDS IN THE SIX MAJOR COAL-PRODUCING STATES
OF THE WEST IN SELECTED YEARS, 1957-1977,
AND COMPARISONS WITH TOTAL U.S. AND TOTAL STATE PRODUCTION
(tons in millions)

YEAR	TOTAL U. S. PRODUCTION			TOTAL PRODUCTION SIX WESTERN STATES ^(a)				FEDERAL LANDS, SIX WESTERN STATES ^(b)				
	SURFACE	UNDER- GROUND	TOTAL	SURFACE	UNDER- GROUND	TOTAL	PERCENT OF U.S.	SURFACE	UNDER- GROUND	TOTAL	PERCENT OF WESTERN	PERCENT OF U.S.
1957	132.1	360.6	492.7	4.6	11.1	15.7	3.2	n.a.	n.a.	4.4	28.0	0.9
1960	130.6	284.9	415.5	5.1	8.5	13.6	3.3	n.a.	n.a.	5.4	39.7	1.3
1962	140.8	281.3	422.1	6.3	7.7	14.0	3.3	n.a.	n.a.	4.9	35.0	1.2
1965	179.4	332.7	512.1	10.3	9.1	19.4	3.8	n.a.	n.a.	5.9	30.4	1.2
1967	203.5	349.1	552.6	12.6	8.6	21.2	3.8	n.a.	n.a.	6.5	30.7	1.2
1971	276.3	275.9	552.2	30.2	9.1	39.3	7.1	n.a.	n.a.	10.1	25.7	1.8
1972	291.3	304.1	595.4	35.0	9.3	44.3	7.4	n.a.	n.a.	8.8	19.9	1.5
1973	292.3	299.4	591.7	43.0	10.0	53.0	9.0	n.a.	n.a.	12.9	24.3	2.2
1974	326.1	277.3	603.4	53.9	10.2	64.1	10.8	n.a.	n.a.	21.5	33.5	3.6
1975	355.6	292.8	648.4	66.9	11.4	78.3	12.1	n.a.	n.a.	31.0	39.6	4.8
1976	383.9	294.8	678.7	82.8	12.5	95.3	14.0	31.7	6.3	38.0	40.2	5.6
1977 ^(c)	416.9	271.6	688.6	105.4	13.4	118.4	17.2	44.0	7.6	51.9	43.8	7.5

(a) Colorado, Montana, New Mexico, North Dakota, Utah and Wyoming.

(b) Total production from Federal lands is for "calendar" years covered; there are differences in some years from other reference data where the latter cover "fiscal" years, i.e., 4.2, 4.9, 9.1 and 10.2 million tons, respectively, in 1960, 1965, 1971, and 1972.

(c) Preliminary

Sources: Reference Numbers 5, 6, 8, 9, and 10.

TABLE 2-8

COAL PRODUCTION FROM FEDERAL LANDS IN SELECTED YEARS
1957-1977 BY STATES
(thousand tons)

	1957 FEDERAL	1962 FEDERAL	1967 FEDERAL	1972 FEDERAL	1973 FEDERAL	1974 FEDERAL	1975 FEDERAL	1976 FEDERAL	1977 FEDERAL
<u>Six Major States:</u>									
Colorado	531	500	2,030	2,386	1,746	2,300	1,600	2,650	4,020
Montana	26	156	115	82	1,940	4,500	9,700	10,500	10,460
New Mexico	34	104	27	206	260	1,000	1,300	1,290	2,340
N. Dakota	412	366	590	1,361	1,535	1,000	300	770	750
Utah	2,957	2,723	1,649	1,980	2,416	3,200	3,800	4,900	5,800
Wyoming	442	1,029	2,112	2,809	4,991	9,500	14,300	17,960	28,290
Sub-total	4,402	4,878	6,523	8,824	12,888	21,500	31,000	38,070	51,660
<u>Other West:</u>									
Arizona	-	-	-	-	-	-	-	-	-
Arkansas	-	-	-	-	-	-	-	-	-
Iowa	-	-	-	-	-	-	-	-	-
Kansas	-	-	-	-	-	-	-	-	-
Missouri	-	-	-	-	-	-	-	-	-
Oklahoma	420	249	144	410	337	-	-	300	240
Washington	-	-	-	-	-	-	-	-	-
Texas	-	-	-	-	-	-	-	-	-
Total Other West	420	249	144	410	337	-	-	300	240
Total West	4,822	5,127	6,667	9,234	13,225	21,500	31,000	38,370	51,900
Total East	764	842	510	988	367	-	-	250	250
Grand Total U.S.	5,586	5,969	7,177	10,222	13,592	-	-	38,620	52,150

(a) Preliminary

Source: Reference Number 5.

TABLE 2-8A
COAL PRODUCTION FROM ALL LANDS IN SELECTED YEARS
1957-1977 BY STATES
(thousand tons)

	1957	1962	1967	1972	1973	1974	1975	1976	1977
	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL
<u>Six Major States:</u>									
Colorado	3,594	3,379	5,439	5,552	6,233	6,896	8,219	9,437	11,920
Montana	413	382	371	8,221	10,725	14,106	22,054	26,231	29,320
New Mexico	137	677	3,463	8,248	9,069	9,392	8,785	9,760	11,255
N. Dakota	2,561	2,733	4,156	6,632	6,906	7,463	8,515	11,102	12,165
Utah	6,858	4,297	4,175	4,802	5,500	5,858	6,961	7,967	9,240
Wyoming	2,117	2,569	3,588	10,928	14,886	20,703	23,804	30,836	44,500
Sub-total	15,680	14,037	21,192	44,353	53,319	64,418	78,338	95,333	118,400
<u>Other West:</u>									
Arizona	-	-	1,000	2,954	3,247	6,448	6,986	10,420	11,475
Arkansas	508	256	189	428	434	455	488	534	570
Iowa	1,312	1,130	883	851	601	590	622	616	525
Kansas	749	915	1,136	1,227	1,086	718	479	590	630
Missouri	2,976	2,896	3,696	4,551	4,658	4,623	5,638	6,075	6,625
Oklahoma	2,195	1,048	823	2,624	2,183	2,356	2,872	3,635	5,345
Washington	360	235	59	2,634	3,270	3,913	3,743	4,109	5,055
Texas	-	18	5	-	6,944	7,684	11,002	14,063	16,765
Total Other West	8,100	6,498	7,791	15,269	22,423	26,787	31,830	40,042	46,990
Total West	23,780	20,535	28,983	59,622	75,742	91,205	110,168	135,375	165,390
Total East	468,924	401,614	523,643	535,764	515,644	512,201	538,270	543,310	521,210
Grand Total U.S.	492,704	422,149	552,626	595,386	591,386	603,406	648,438	678,685	688,600 ^(a)

(a) Preliminary

Source: Reference Number 5.

TABLE 2-9
COAL SHIPMENTS FROM THE WESTERN STATES IN 1976
BY CONSUMER CLASSIFICATIONS
(thousands of short tons)

	ELECTRIC POWER UTILITIES	COKE PLANTS	RETAIL DEALER DELIVERIES	OTHER	TOTAL
Colorado	5,984	2,583	31	806	9,404
Montana	26,038	-	-	397	26,435
New Mexico	8,516	858	-	345	9,719
No. Dakota	10,257	-	86	748	11,091
Utah	3,915	1,453	243	1,785	7,396
Wyoming	28,282	-	109	2,761	31,152
Subtotal	82,992	4,894	469	6,842	95,197
Oklahoma	2,497	491	4	319	3,311
Subtotal	85,489	5,385	473	7,161	98,508
Arizona	10,258	-	-	102	10,360
Washington	4,087	-	-	24	4,111
Subtotal	14,345	-	-	126	14,471
Grand total	99,834	5,385	473	7,287	112,979

Source: Reference Number 5.

2.5 TRENDS IN OTHER SOURCES OF ENERGY

Historically, the United States was able to supply its oil and gas needs largely from domestic sources. However, it now appears that, although world oil and gas supplies might be adequate for some time, continued reliance on these fuels will leave the United States very heavily dependent on foreign nations for its basic energy requirements. The undesirable national security, economic, and other implications of such heavy dependence on foreign energy sources have forced a major national reassessment of future energy directions.

2.5.1 Oil Production Trends

The production of oil in the United States peaked in 1970 and, despite the stimulus of sharply increased prices over the past 5 years, there has been a continuing domestic production decline. As shown in Table 2-10, the decline in domestic production had to be offset by a large increase in oil imports to meet rising demand. Although overall demand dropped in 1974 and 1975, it again increased in the past two years.

The domestic production decline has been matched by a comparable decline in proven reserves. The discovery of the nearly 10-billion barrel Prudhoe Bay field in Alaska gave a large boost to reserves in the late 1960's. But, by 1975, U.S. crude oil reserves had fallen to a level largely equivalent to the level 10 years earlier (see Table 2-11). Reserves have continued to drop despite the large increase in the number of wells drilled. There were 44,982 completed wells in 1977, the highest level since 1960 [11].

Sustaining the existing level of domestic oil production will not be easy. At current production rates, more than 25 billion barrels of oil will have to be discovered by 1985 to keep the reserves/production ratio from dropping further. While new discoveries are continually being made, they are more difficult and expensive to produce as the easier finds are exhausted. The greatest potential for new finds appears to be in costly offshore areas.

Stable or declining domestic oil production would have fundamental national security and economic implications. The U.S. payments for foreign oil imports rose from \$2.0 billion in 1965 to \$41.8 billion in 1977 (see Table 2-12). These payments were a principal factor in the U.S. foreign trade deficit in 1977 of \$26.5 billion and the international decline in the value of the dollar. Projections of future oil imports indicate that U.S. payments for foreign oil could be as high as \$60 billion by 1985 [11].

The effect of increased coal production, even of modest magnitude, will be significant in terms of reducing dependence on imported oil. By increasing coal production from the 1976 level of 679 million tons to a 1985 production level of 1.2 billion tons, the importing of around 2.4 million barrels of oil a day, or 803 million barrels a year could be avoided. This would result in reductions in import payments of more than \$10 billion.

2.5.2 Natural Gas Production Trends

The domestic production of natural gas has closely followed the pattern of crude oil. Natural gas output peaked in 1973 and has since declined. The proven reserves of natural gas have declined since the mid-1960's, as shown in Table 2-

13. Unlike petroleum, natural gas imports amounted to only about 5 percent of total U.S. consumption in 1977 and have not made up for domestic production declines. Falling gas supplies have caused gas distributors to curtail and/or interrupt deliveries to industrial customers, restrict the hook-up of new residential and commercial accounts, and limit boiler fuel usage.

The extent to which natural gas will be available to meet future energy requirements is very uncertain at this time. Large foreign supplies of natural gas may be obtained from Mexico or could be transported in liquified form from more distant foreign supply areas. Domestically, Alaskan gas could provide substantial supplies or exploration on the outer continental shelf might result in discovery of significant amounts of gas. The recently enacted Natural Gas Policy Act of 1978 aims to stimulate greater production of domestic gas supplies by raising the regulated price and providing for deregulation by 1985.

The conversion of coal into synthetic gas is expected to have considerable importance at some time in the future. However, high costs and uncertain technology make it unlikely that large supplies of synthetic gas could be produced before the 1990's [7].

2.5.3 Nuclear Power Trends

Nuclear power plants produced 11.8 percent of the Nation's electric power in 1977. At that time there were 68 nuclear power plants in operation or in the startup phase with a total capacity of more than 49,000 megawatts. As shown in Table 2-14, 154 other nuclear plants were being built, on order, or announced with a total design capacity of 172,000 megawatts. If all these plants were to be in operation by 1990, they would provide as much as 27 percent of expected national power requirements.

Nuclear plants are currently cost competitive with coal plants and rapid expansion of nuclear power generation could significantly diminish future coal requirements. In recent years, however, the expected growth rate of nuclear energy has been sharply reduced by a number of concerns about its cost and safety. Safety concerns have involved questions of nuclear proliferation, radiation hazards, spent-fuel storage, and radioactive waste management [7].

2.5.4 Hydroelectric Power Trends

Hydroelectric plants in 1977 accounted for 68,300 megawatts, or 12 percent of the total installed electrical generating capacity of the United States. This was about 25 percent less than in 1974 and 1975, due primarily to drought conditions in many western states. In the 1930's and 1940's, hydroelectric power provided as much as 30 percent of total domestic electricity needs. Although hydroelectric power is relatively safe, nonpolluting, low in cost, and does not consume fuels, its expansion in recent years has been limited by the lack of good new sites and opposition on environmental and cost grounds. The possibilities for expanding capacity at existing dams and for development of hydroelectric facilities on smaller rivers and streams for more local use are being investigated [7].

TABLE 2-10

U.S. PETROLEUM SUPPLY AND DEMAND
(thousands of barrels per day)

YEAR	PRODUCTION ^(a)	IMPORTS ^(b)	DEMAND ^(c)
1965	9014	2467	11709
1970	11297	3419	14968
1971	11156	3925	15449
1972	11185	4741	16602
1973	10946	6256	17552
1974	10462	6112	16886
1975	10007	6056	16545
1976	9736	7312	17698
1977 ^(d)	9834	8708	18666

(a) Crude oil, lease condensate and natural gas liquids

(b) Crude oil and refined products

(c) May not add up due to losses, changes in stock, and exports

(d) Preliminary

Source: Reference Number 7.

TABLE 2-11

U.S. PROVEN RESERVES OF CRUDE OIL
(billions of barrels)

YEAR END	RESERVES	RATIO RESERVES/PRODUCTION
1965	31.3	9.5
1970	39.0	9.5
1971	38.0	9.3
1972	36.3	8.9
1973	35.3	8.8
1974	34.2	8.9
1975	32.6	8.9
1976	30.9	8.7
1977	29.5	8.2

Source: Reference Number 11.

TABLE 2-12

VALUE OF CRUDE OIL/PETROLEUM PRODUCT IMPORTS, 1965 TO 1977
(millions of current dollars)

YEAR	CRUDE OIL	PETROLEUM PRODUCTS	TOTAL
1965	\$1,120	\$ 924	\$2,044
1970	1,260	1,483	2,743
1971	1,687	1,656	3,343
1972	2,369	1,989	4,358
1973	4,240	3,498	7,738
1974	15,253	11,013	26,266
1975	18,290	6,768	25,058
1976	25,456	6,646	32,102
1977 ^(a)	33,398	8,413	41,811
^(a) Preliminary			

Source: Reference Number 7.

TABLE 2-13

U.S. PROVEN RESERVES OF NATURAL GAS
(trillion cubic feet)

YEAR	RESERVES
1965	286.5
1970	290.7
1971	278.8
1972	266.1
1973	250.0
1974	237.1
1975	228.2
1976	216.0
1977	208.9

Source: Reference Number 11.

TABLE 2-14
STATUS OF NUCLEAR POWERPLANTS, END OF 1977

STATUS	NUMBER	CAPACITY (Megawatts)
In Operation or Startup	68	49,000
Construction Permit Granted	80	87,000
Construction Started	(67)	(73,000)
No Construction	(13)	(14,000)
Construction Permit Pending	52	58,000
Order Placed for Plant	13	16,000
Announced	9	11,000
	<hr/> 222	<hr/> 221,000

Source: Reference Number 7.

2.5.5 Nontraditional Energy Sources

Although a number of nontraditional energy sources are under active investigation, these efforts are still mostly in their infancy and these sources are not expected to make a significant contribution to energy supplies by 1990. These sources are briefly described below.

2.5.5.1. Unconventional Sources of Gas. There are four types of gas resources receiving the greatest current attention. The first is gas in geopressured zones of the Gulf Coast in the form of methane-rich waters at depths below 10,000 feet. Although estimated to encompass a vast resource base (3,000 to 50,000 trillion cubic feet), there are numerous technical and environmental problems to be resolved before gas from this resource can be developed [7]. The second is gas in "tight" (impermeable) sandstone formations in the Rocky Mountain States. Again, the resource is considerable but the recovery technology has yet to be developed. Gas is also found in Devonian Shales of the Appalachian States. This gas is currently being produced in local areas and efforts are underway to enhance production. Finally, recovery of methane from coal seams in advance of mining operations is technologically possible. Production of this resource would improve mine safety and make a regionally important impact on gas supply availability [7]. Uncertainty about legal ownership of coal seam methane and the right to produce it are currently inhibiting its production.

2.5.5.2 Oil Shale. High grade deposits of oil shale, located primarily in Colorado, Utah, and Wyoming, may contain as much as 600 billion barrels of oil, and lower grade deposits may contain an additional 1.2 trillion barrels. Given favorable economic conditions, as much as 80 billion total barrels of shale oil could be extracted from this resource. A number of optimistic production forecasts were made in the 1973-74 period; it soon became evident, however, that production costs would be much higher than originally expected. Unless there are breakthroughs in technology, shale oil is not expected to be competitive with oil and gas until their prices rise considerably above current levels. Even then, shale development might not be competitive because historically increases in prices have tended to lag behind increases in cost [7].

2.5.5.3 Tar Sands. Although found in at least nine states, the largest known resource of bitumen-bearing rocks (tar sands) is located in Utah, encompassing a resource base roughly equivalent to 28 billion barrels of oil. Because of various constraints and high extractive costs, production from this resource is not expected to be significant in the near future [7].

2.5.5.4 Alcohol Fuel Uses. Alcohol fuels include methanol and ethanol. Most methanol traditionally comes from natural gas. However, methanol can also be produced from coal or biomass sources.

Ethanol can be produced by the direct hydration of ethylene gas and by the process of fermentation and distillation using various agricultural products such as grain or molasses as feed stock. Ethanol fuel may be a way to effectively use extensive food and grain surpluses in the United States and Canada.

Satisfactory engine operation is possible on existing automobiles that are fueled with up to 15 percent methanol or ethanol gasoline blends and require no carburation readjustment. Also, the present automobile engine can be retrofitted to run successfully on 100 percent methanol. Brazil has been producing ethanol from excess sugar and is using ethanol gasoline blends as an automobile fuel. However, there is a great deal of uncertainty about the prospects for a nationwide alcohol-gasoline fuel system based on alcohols derived from biomass resources. The principle disadvantages of alcohols are their toxicity, with ethanol being the least toxic. Methanol vapors are more toxic than gasoline vapors. Other methanol disadvantages are its poor cold start capability, aldehyde emissions, and a lower heat of combustion.

An advantage to the use of alcohols in gasoline relates to fuel octane rating. When added to gasoline, both methanol and ethanol boost the octane value of the original gasoline in much the same way as tetra-ethyl lead and no-lead additives in gasoline [22].

2.5.5.5 Geothermal Energy. While it constitutes an enormous potential resource base, the heat of the earth has so far seen limited use as an energy source. Natural hot dry steam at Geysers, California, is the fuel source for a 520-megawatt electricity generating plant. Hot water in Oregon, Idaho, and other western states has been used for local space heating purposes. Other plans are currently being developed to employ hot waters for power production in certain western states and Hawaii and for space heating in several eastern states. However, there is still a great deal of uncertainty about reservoir longevity, since these hot waters are essentially nonrenewable. This feature, combined with technological difficulties and problems of corrosion, has tended to discourage private investment thus far [7].

2.5.5.6 Solar Energy. The basic solar energy categories are solar heating and cooling of buildings, agricultural and industrial process heat, wind energy conversion, photovoltaic conversion, solar thermal conversion, and biomass. Solar heating and cooling, agricultural and industrial process heat, wind energy, and biomass appear to have potential for significant uses between now and 1990. Technologies need to be developed further for other solar energy sources to attain a reasonably competitive level. On an overall basis, solar energy is not expected to contribute more than 1 to 2 percent of the total water and space heating energy requirements by 1990. Its impact is more likely to be felt in the period between 2000 and 2020, when forecasts suggest that as much as 10 percent of U.S. energy needs could be met by solar sources. Technological breakthroughs, major subsidy programs, or other developments could cause the earlier use of this resource [7].

2.5.5.7 Energy from the Ocean. The renewable energy sources from the ocean include the following:

- Ocean thermal energy conversion - based on harnessing the thermal differences of at least 17°C between warm surface water and cold deep sea water (found primarily between the Tropics of Cancer and Capricorn).
- Tidal energy conversion - plants proposed for two potential sites in the United States, one in Maine at the

Bay of Fundy and the second in Cook Inlet, Alaska. The maximum total capacity of these plants would be 3,600 megawatts and the annual energy output would represent about 1 percent of the electricity produced in the United States.

- Other ocean energy forms that have been the subject of limited study are wave energy, ocean current energy, ocean wind energy, and salinity gradient energy conversion [7].

These sources are not expected to provide significant amounts of energy until the 2000-2200 period at the earliest.

2.5.5.8 Nuclear Fusion. Although it would use low cost, inexhaustible fuels, nuclear fusion is generally considered environmentally more desirable than nuclear fission plants. Although the feasibility of key design principles was recently verified in an important experiment at Princeton University, there are major engineering problems to be overcome before nuclear fusion is a reality. Even if problems are successfully resolved, nuclear fusion cannot be expected to make a major contribution for probably another 50 years [7].

2.5.6 Energy Conservation

There are significant possibilities for reducing energy needs through conservation. In many cases, conservation measures might well be more cost effective than development of new energy sources.

The National Energy Plan formally proposed by President Carter in 1977 [12] called for measures such as wellhead taxes on crude oil, phased deregulation of natural gas prices, taxes on industrial use of oil and gas, and selected electricity rate policies, all of which were designed at least in part to dampen and discourage wasteful energy consumption practices. Residential conservation possibilities include weatherization of homes, use of more efficient appliances, and installation of heat pumps. Transportation energy use could be reduced by improvements in operating procedures, new equipment, pumping technologies, and modifications of motor vehicle engine propulsion systems. Possible areas of savings in the industrial sector include waste heat utilization, industrial waste application and process changes.

The various conservation measures could have a substantial impact on energy consumption, reducing it by perhaps as much as 10 percent by 1990 if there are major technology advances. Whether such large scale energy savings will be achieved through conservation efforts still remains, however, an open question [7].

2.6 EXPECTED FUTURE COAL USE

While the precise rate is in considerable doubt, there is little question that the Nation's overall energy requirements will continue to grow. There is little likelihood of supplying that growth from domestic oil and natural gas (see discussion in Sections 2.5.1 and 2.5.2). New technologies and energy forms are still unproven, and cannot be relied on over the next decade or so. Nuclear power could supply large amounts of additional energy, but for the time being its growth is inhibited by concerns about its safety. Given these circumstances, in the next decade the United States will be forced to address the problem of growing energy demands

largely through a combination of three basic types of actions: (1) expand use of coal as a domestic energy source; (2) obtain increased foreign supplies of oil and gas; and (3) curb demands by greater energy conservation measures.

2.6.1 Coal in the National Energy Plan

The role of coal in the President's April 1977 National Energy Plan was previously discussed in section 1.4.1. The National Energy Plan included a reduction in the expected level of imports of foreign oil as a prime objective. It proposed to reduce foreign imports from a projected level of 11.5 million barrels per day in 1985 without the Plan, to 7.0 million barrels per day with the Plan. This reduction was to be achieved by adoption of additional conservation measures (2.1 million barrels per day of oil saved) and by increased substitution of coal for oil and gas (2.4 million barrels per day).

Under the National Energy Plan, total coal production was expected to rise from 679 million tons per year in 1976 to 1.26 billion tons per year in 1985. This would represent an increase in coal production of about 200 million tons per year more than would have been expected without the Plan.

2.6.2 Department of Energy Coal Projections

Projections of future energy production and consumption are based on many assumptions. Inevitably, these assumptions change, sometimes rapidly. Accordingly, it is necessary to use the best projections possible at a given time, while remaining ready to revise the projections as circumstances are altered. Already, the projections in the National Energy Plan are somewhat out of date, and are being revised.

In preparing this programmatic environmental impact statement it seemed desirable to have the most current projections of future coal production. A regional breakdown with a fairly high degree of geographic resolution was also needed for the analytical purposes of this statement. Accordingly, the Department of the Interior requested that the Department of Energy (DOE) provide a new set of coal production projections especially developed for use in the preparation of this statement. These projections for 1985 and 1990 were developed by the DOE Leasing Policy Development Office and submitted in a report to the Department of the Interior in June 1978 [13]. This report is available upon request.

The DOE energy and consumption projections incorporate assumptions on future electric power requirements, oil and gas prices, and nuclear power development. Other assumptions involve air quality controls, transportation costs, and labor cost escalation. Different sets of assumptions were developed for low, medium, and high projections of western coal development. For example, the low oil price assumption for 1985 was \$13 per barrel, the medium assumption \$15 per barrel, and the high assumption \$20 per barrel. The electric power annual growth rate, which is the single most important assumption, was 4, 4.8, and 5.8 percent for the 1985 low, medium, and high projections, respectively. The low assumptions were selected to favor energy sources other than coal and to favor eastern sources for coal produced. The high assumptions favor both higher coal use

ROLE OF WESTERN AND FEDERAL COAL

and western coal production. Low, medium, and high projections were generated for both 1985 and 1990.

The DOE projections were obtained from a large linear programming model and were calculated using a computer. For each coal model demand region, the model user specifies in advance electric power consumption, industrial coal use, and other types of coal use. The model then calculates the lowest cost way of providing for these electric power and coal use requirements for all the demand regions in the United States. Mining, transportation, and air quality control costs are among the costs considered. The model can make decisions to switch among alternative energy sources, to keep old plants operating or to build new ones and to change the distribution between base, intermediate, and peak load plants. There is no distinction in the model between Federal and non-Federal coal reserves; essentially all reserves are considered available for production.

Table 2-15 shows the DOE national coal consumption projections for 1985 and 1990, broken down by types of use. Under assumptions of medium use, consumption of coal by utilities is projected to rise by 60 percent between 1977 and 1985, from 475 to 760 million tons a year. The other main increase in coal consumption is in the industrial sector, where coal use is projected to grow by 98.7 million tons, from 60 million tons in 1977 to 159 million tons in 1985.

Total coal consumption for 1985 is projected to be 1.11 billion tons under medium level assumptions. This is a decline of about 150 million tons per year from the projected 1985 production level under the National Energy Plan, reflecting reduced projections especially for industrial coal use.

The medium level increase in national coal production projected between 1985 and 1990 is 37 percent. Most of this increase is due to greater use of coal by utilities. Industrial coal use has a more rapid rate of growth, but the increase is considerably less in absolute amount.

The projections for synthetic uses of coal assign them a minor role in 1985 (23 million tons). By 1990, synthetics are projected to grow by two and one-half times, but would still not be major uses of coal.

Table 2-16 shows the regional breakdown of total coal production projected by DOE. By 1985, coal production west of the Mississippi River is projected to reach 42 percent of the national total (medium assumptions). By 1990, projected western production would reach 50 percent of the national total, corresponding roughly to the percentage of reserves located in the West.

The Northern Great Plains (essentially Wyoming, Montana and North Dakota in the DOE model) would become the largest single producing section of the country if the DOE projections are realized. By 1990, Northern Great Plains coal production would exceed both Appalachian and Midwestern production and would constitute 36 percent of national production. By comparison, in 1977 production from the Northern Great Plains was 13 percent of national production, much higher than only a few years earlier.

In Table 2-17, DOE projections are shown for the western coal regions selected for assessment in this environmental impact statement. As might be expected, considering its huge reserves of low sulfur coal obtainable at low cost by surface mining, the Powder River Coal Region plays a central role in predicted western coal production. DOE projects coal

production in the Powder River Coal Region to be 205 million tons per year in 1985 and 396 million tons per year in 1990 under its medium projection. These amounts represent 43 and 52 percent of total western coal production projected for those years, and 18 and 26 percent of national production.

Other major producing regions after the Powder River Coal Region are the Green River-Hams Fork and San Juan River Coal Regions. Assuming medium consumption levels, production of 112 million tons a year in 1985 and 150 million tons a year in 1990 is projected for the Green River-Hams Fork Coal Region, or 24 and 20 percent of total western production projected for those years. The San Juan River Coal Region is projected to have production of 23 million tons per year in 1985 and 58 million tons per year in 1990, or 5 and 8 percent of western production, respectively.

Although not shown in Table 2-17, the great majority of the coal production projected by DOE is expected to be surface mined. In the Fort Union and Powder River Coal Regions, all the coal production is expected to be surface mined. Underground mining represents a major share of projected production only in the Uinta-Southwestern Utah Coal Region (85-90 percent). Of overall western coal production projected for 1985 and 1990, only 6.9 percent and 5.9 percent, respectively, are forecasted by DOE to be mined underground.

The development of western coal has been stimulated by the greater ease with which low sulfur coal can meet air quality standards, creating a demand in the East for western coal. However, the most important sources of increased demand for western coal are in the West itself. In time, the West is expected to move from its traditional reliance on oil, gas, and hydropower to a new use of coal-fired plants for its electric power. In Table 2-18, the DOE projected transportation of western-produced coal to eastern and western consumption regions is shown. Overall, both for 1985 and 1990 medium forecasts, 18 percent of western production is projected to be consumed in the East and Midwest. While this is not a high percentage, substantial amounts of coal would nevertheless still be shipped east. Under DOE's 1990 high assumptions, which involve low transportation costs, less strict sulfur scrubbing requirements, higher labor costs, and other assumptions designed to promote western production, 299 million tons per year of western coal would move to the East.

The traditional modeling of the energy sector of the economy, as reflected in the DOE coal model, related energy use to macroeconomic variables such as income. A new alternative approach currently is being employed in California that projects energy consumption based on a detailed survey of households, businesses, and institutions. To complete the comprehensive inventory on a nationwide basis with the survey method used in California would take considerable time and resources. But the preferred coal management program designed by the Interior Department contains a biennial examination of projections. If it should prove desirable, it will be possible for the Federal Government to undertake the kind of end use modeling carried out in California or other alternatives to the DOE methods used for the current projections.

TABLE 2-15
NATIONAL COAL CONSUMPTION
(million tons)

CONSUMING SECTOR	1977	1985			1990		
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Electric Utility	475	692.4	759.5	816.1	772.4	1,007.1	1,276.7
Industrial	60	109.1	158.7	158.1	138.2	279.4	279.3
Metallurgical	77	96.1	96.2	96.2	100.0	100.0	100.1
Residential/Commercial	7	1.5	1.5	1.5	0.7	0.7	0.7
Synthetics	--	13.1	22.5	41.3	26.3	56.2	122.1
Exports	<u>54</u>	<u>72.5</u>	<u>73.7</u>	<u>73.6</u>	<u>76.3</u>	<u>77.2</u>	<u>77.1</u>
Total	673	984.7	1,112.1	1,186.8	1,113.9	1,520.6	1,856.0

Source: Reference Number 13.

TABLE 2-16

DETAILED REGIONAL COAL PRODUCTION FORECASTS
(million tons)

AREA	1977	1985			1990		
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Northern Appalachia	173.0	208.6	213.0	223.4	194.0	225.3	253.3
Central Appalachia	195.5	196.9	205.2	209.7	188.4	206.2	211.6
Southern Appalachia	21.2	21.4	21.4	21.4	13.8	13.8	13.8
Total	389.7	426.9	439.6	454.5	396.2	445.3	478.7
Midwest	132.7	182.7	204.4	213.4	264.2	312.3	327.3
Total	132.7	182.7	204.4	213.4	264.2	312.3	327.3
E.Northern Great Plains	12.5	20.3	21.9	25.3	23.8	22.5	36.4
W.Northern Great Plains	73.9	223.4	305.6	348.9	267.7	529.0	763.7
Total	86.4	243.7	327.5	374.2	291.5	551.5	800.1
Central West	13.7	8.9	10.6	10.9	9.6	10.3	9.6
Gulf	16.8	57.7	57.7	57.7	62.3	79.6	104.1
Rocky Mountains	20.7	38.8	43.8	44.6	43.7	53.3	53.1
Southwest	22.7	25.8	28.3	28.5	39.9	65.0	79.9
Northwest	5.0	5.6	4.4	4.4	7.0	3.7	3.7
Total	78.9	136.8	144.8	146.1	162.5	211.9	250.4
TOTAL	687.7	990.1	1,116.3	1,188.2	1,114.4	1,521.0	1,856.5

Source: Reference Number 13.

TABLE 2-17

DOE PRODUCTION PROJECTIONS FOR WESTERN COAL REGIONS
(million tons)

COAL REGION	1985 PROJECTION			1990 PROJECTION		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Western Interior	8.9	10.6	10.9	9.6	10.3	9.6
Fort Union	18.4	20.0	23.4	21.9	20.6	34.5
Powder River	140.4	204.6	232.1	173.7	396.1	602.9
Green River-Hams Fork	89.9	112.0	128.8	105.9	149.5	177.7
Uinta-Southwestern Utah	25.7	26.4	26.3	25.1	28.3	27.9
San Juan River	20.1	22.8	22.9	34.5	58.4	72.5
Denver Raton Mesa	5.3	5.3	5.2	5.4	6.8	6.6
Texas	57.7	57.7	57.7	62.3	79.6	104.1
Total (a)	366.4	459.4	507.3	438.4	749.6	1035.8

(a) Excludes production from Arizona, Washington, and Alaska.

Note: The DOE estimates have been revised slightly for purposes of this table.

Source: Reference Number 13.

TABLE 2-18

EASTERN AND WESTERN CONSUMPTION OF WESTERN COAL
(million tons)

	1985			1990		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Western Coal Consumed in the East	74.0	87.3	93.0	75.6	136.0	299.0
Western Coal Consumed in the West	306.4	384.7	426.9	378.2	627.3	750.4
Total Western Coal	380.4	472.0	519.9	453.8	763.3	1049.4

Source: Reference Number 13.

2.7 WESTERN COAL SUPPLY SOURCES

The DOE forecasts of future coal production were based on the assumption that Federal and non-Federal coal reserves would be fully available to meet demands for western coal. The forecasts did not address the questions of which particular reserves might be developed, and whether they were already producing or were likely to be able to enter into production.

2.7.1 Production Potential of Federal Coal

Future production of Federal coal reserves can come either from already issued Federal leases or from new leases. There are currently 534 outstanding Federal coal leases which are estimated to contain 17 billion tons of recoverable reserves (see Table 2-19). Sixty-seven percent of existing lease reserves are surface minable. The Powder River Coal Region contains 58 percent of existing lease reserves, most of which are surface minable and are located in the Wyoming part of the region. Surface minable reserves in the Powder River Coal Region represent 82 percent of all surface minable reserves in existing Federal leases. The Uinta-Southwestern Utah Coal Region has the second largest amount of reserves in existing leases, 4.5 billion tons. Sixty-nine percent of these reserves are underground reserves located in the Utah part of the region. The Powder River and Uinta-Southwestern Utah Coal Regions together account for 84 percent of existing lease reserves.

Estimates of recoverable reserves from existing leases were made by Geological Survey (GS) mining supervisors (75 percent of lease reserves), by GS area or district geologists (8 percent), by the lessees (8 percent) or by unspecified parties (4 percent). The General Accounting Office has criticized the Interior Department's lease reserve estimates as not sufficiently accurate, particularly on an individual lease basis [16]. The Department is currently undertaking to improve the accuracy of reserve information, and plans to request lessees to provide new reserve data in order to bring reserve estimates into conformance with the standards for reserves in GS Bulletin 1450B [17].

By 1977, annual production from existing Federal leases reached 51.9 million tons. Substantial further increases in production can be expected from these leases by 1986, both from leases already included in mine plans and from leases which are not currently included in mine plans. After 1986, further expansions in production of Federal coal would have to come either through greater production from already operating mines containing Federal coal or through new Federal leasing. If existing leases issued prior to 1976 are not in production by 1986, under current regulations they would be subject to cancellation for failure to meet diligent development requirements. The Department at present expects that the great majority, if not all, such existing leases would be cancelled if they are not producing by 1986.

2.7.1.1 Planned Production from Existing Leases with Mine Plans. As of June 1978, the Department had received 119 mine plans that were approved or were pending approval. The 223 Federal leases included in these mine plans contain 9.3 billion tons of recoverable reserves, representing 54 percent of the reserves in all existing Federal leases. In 1977, production from mines including Federal leases was 96.3 million tons, representing 82 percent of total 1977 coal production in the six

western Federal coal states. Only a little more than half of this production represented Federal coal, since a number of the mines also include non-Federal coal. Federal coal is expected to constitute a much larger share of future planned production from mines including Federal leases.

In Table 2-20, planned production from approved and pending mine plans containing Federal leases is shown. These planned production estimates were made in March 1978 by the Geological Survey on the basis of mine plans submitted, known contracts, discussions with lessees, and other information. The total production planned for 1985 from mines including Federal leases is 308.6 million tons. Almost two-thirds of the planned production is expected from the Powder River Coal Region, which is consistent with the large supply of low cost, surface minable reserves in existing leases in this region. Although not shown in Table 2-20, 82 percent of the total production planned in the Powder River Coal Region would come from Wyoming and only 18 percent from Montana.

The production planned for approved and pending mine plans may not all occur. The most important potential constraint is lack of demand; the coal would only be produced if there is a market for it. Some pending mine plans may never be approved (for example, they could be located in an alluvial valley, or require a new transportation system with unacceptable environmental impacts). Planned production may also not materialize if other coal proves to be cheaper to mine or higher in quality. Nevertheless, total production planned from approved and pending mine plans provides a good indication of the production potential of these mines.

2.7.1.2 Likely Production from Existing Leases Without Mine Plans. In addition to the 223 Federal leases included in mine plans, there are an additional 311 Federal leases, representing 46 percent of existing Federal lease reserves, for which no mine plans have been submitted to the Department. In order to obtain an estimate of the production potential of these leases, the Geological Survey was requested as part of the Department's coal policy review to give its best judgment as to whether such leases were "more likely than not" to be in production by 1986 in time to meet diligent development standards. These judgments were made in March 1978 by GS mining supervisors, taking into account demand for the coal type, environmental problems of the lease site, transportation availability, mining costs, lease size and other factors. Of the 7.8 billion tons of total reserves in existing leases without mine plans, the GS estimated that leases containing 1.7 billion tons of reserves were likely to be in production by 1986 and leases containing 6.1 billion tons of reserves were not likely to be in production by 1986. Reserves in leases believed likely to be producing by 1986 would be sufficient to sustain an annual production rate of 57.3 million tons a year. Leases containing other reserves would be subject to cancellation in 1986 for failure to be diligently developed.

In Table 2-21 the likely regional production from Federal lease reserves which are not now in mine plans but which are considered likely to be producing by 1986 is shown. The Uinta-Southwestern Utah Coal Region has the largest share, 41 percent of likely production. In other regions, there is only a small amount of likely production from Federal leases

TABLE 2-19
RECOVERABLE COAL RESERVES IN EXISTING FEDERAL LEASES ^(b)

COAL REGION	NUMBER OF LEASES	ACREAGE LEASED	RECOVERABLE SURFACE RESERVES (million tons)	RECOVERABLE UNDERGROUND RESERVES (million tons)	TOTAL RECOVERABLE RESERVES (million tons)
Fort Union					
North Dakota	17	15,515	(a)	0.0	(a)
Montana	<u>3</u>	<u>6,056</u>	<u>(a)</u>	<u>0.0</u>	<u>(a)</u>
Total	20	21,571	540.0	0.0	540.0
Powder River					
Montana	13	30,161	(a)	(a)	993.8
Wyoming	<u>56</u>	<u>132,202</u>	<u>(a)</u>	<u>(a)</u>	<u>8,888.3</u>
Total	69	162,363	9,471.2	410.9	9,882.1
Green River-Hams Fork					
Wyoming	38	82,452	374.6	547.7	922.3
Colorado	<u>34</u>	<u>33,946</u>	<u>289.8</u>	<u>198.3</u>	<u>488.1</u>
Total	72	116,398	664.4	746.0	1,410.4
Uinta-Southwestern Utah					
Utah	199	271,326	267.0	3,089.3	3,356.3
Colorado	<u>67</u>	<u>73,790</u>	<u>168.9</u>	<u>971.6</u>	<u>1,140.5</u>
Total	266	345,116	435.9	4,060.9	4,496.8
San Juan River					
New Mexico	25	40,757	273.1	(a)	(a)
Colorado	<u>7</u>	<u>10,242</u>	<u>0.0</u>	<u>(a)</u>	<u>(a)</u>
Total	32	50,999	273.1	127.5	400.6
Denver-Raton Mesa					
Colorado	6	3,686	25.6	(a)	(a)
New Mexico	<u>3</u>	<u>201</u>	<u>0.0</u>	<u>(a)</u>	<u>(a)</u>
Total	9	3,887	25.6	22.8	48.4
Other Regions	66	90,482	74.2	235.6	309.8
GRAND TOTAL	534	790,816	11,484.4	5,603.7	17,088.1

(a) Cannot be disclosed because of confidentiality requirements.
(b) Includes leases issued prior to March, 1978.

TABLE 2-20

PLANNED 1985 PRODUCTION FROM APPROVED AND PENDING MINE PLANS
CONTAINING FEDERAL LEASES (a)

COAL REGION	NUMBER OF LEASES IN MINE PLANS (b)	RECOVERABLE FEDERAL RESERVES IN MINE PLANS (million tons)	1985 PLANNED PRODUCTION (million tons/year)
Fort Union	4	(b)	5.9
Powder River	35	6,025	201.5
Green River-Hams Fork	49	1,148	42.9
Uinta-Southwestern Utah	114	1,859	43.3
San Juan River	8	98	10.5
Denver-Raton Mesa	1	(b)	0.002
Other Regions	<u>12</u>	<u>54</u>	<u>4.5</u>
Total	223	9,306(c)	308.6

- (a) Estimates based on March 1978 Department of the Interior review of existing Federal leases.
 (b) Cannot be disclosed because of confidentiality requirements.
 (c) Includes total recoverable reserves in mine plans in Fort Union and Denver-Raton Mesa Coal Regions.

TABLE 2-21

LIKELY 1985 PRODUCTION FROM EXISTING FEDERAL LEASES WITHOUT MINE PLANS^(a)

COAL REGION	NUMBER OF LEASES WITHOUT MINE PLANS	RECOVERABLE RESERVES IN FEDERAL LEASES WITHOUT MINE PLANS (million tons)	RECOVERABLE RESERVES IN LEASES WITHOUT MINE PLANS LIKELY TO BE PRODUCING IN 1985 (million tons)	LIKELY PRODUCTION IN 1985 FROM LEASES WITHOUT MINE PLANS (d) (million tons/year)
Fort Union	16	(b)	(b)	(b)
Powder River	34	3,857	210	7.0
Green River-Hams Fork	23	262	204	6.8
Unita-Southwestern Utah	152	2,638	700	23.3
San Juan River	24	303	254	8.5
Denver-Raton Mesa	8	(b)	(b)	(b)
Other Regions	<u>54</u>	<u>256</u>	<u>46</u>	<u>1.5</u>
Total	311	7,782(c)	1,718(c)	57.3

(a) Estimates based on March 1978 Department of the Interior review of existing Federal leases.

(b) Cannot be disclosed because of confidentiality requirements

(c) Includes total recoverable reserves in mine plans in Fort Union and Denver-Raton Mesa Coal Regions.

(d) Assumes 30 year mine life.

beyond that expected from already approved or pending mine plans.

There are many possible reasons why an existing Federal lease might not be put into production by 1986. Many of the leases are small and would require additional Federal leasing or acquisition of other coal rights to form economically viable, or logical, mining units. Others are located far from transportation routes or are in areas with environmental problems. Coal quality is poor and mining costs high in some cases, and there may not be a sufficient demand for the types of coal contained in some leases.

In the Uinta-Southwestern Utah Coal Region, for example, existing leases contain 4.5 billion tons of reserves, most of them for underground mining. These reserves would be sufficient to sustain mines with an annual production rate of 150 million tons per year. However, the DOE 1985 medium production projection for the Uinta-Southwestern Utah Coal Region is only 26.4 million tons (see Table 2-17), some of which would be provided by non-Federal coal. Even if the DOE projections are low, a large part of the reserves in the existing Federal leases in the Uinta-Southwestern Utah Coal Region have very little chance of entering into production by 1986. These nonproducing reserves are likely to be the reserves with higher mining costs, more distant from transportation routes, and with other problems.

Similarly, in the Powder River Coal Region, the one other region with major reserve holdings in existing Federal leases, the 9.5 billion tons of surface minable reserves in existing leases could sustain production of 317 million tons per year. The DOE medium projection for this region in 1985, however, is only 205 million tons and even the high projection is only 232 million tons. The low 1985 projection is 140 million tons. Hence, a significant amount of existing lease reserves in the Powder River Region also are unlikely to be producing in time to meet the 1986 diligence standard. Nonproducing reserves here would also generally be the ones which are of relatively lower quality.

2.7.1.3 Preference Right Lease Applications. Another important potential source of Federal coal production is contained in preference right lease applications (PRLAs). Until preference right leasing was ended in the early 1970's (officially by the Federal Coal Leasing Amendments Act of 1976), the government issued prospecting permits in areas where coal was not known to exist in economically valuable deposits. A holder of a prospecting permit discovering a high quality deposit could apply for and obtain a lease to mine the deposit by demonstrating that it contained commercially valuable coal. Such leases were called preference right leases and were issued on a noncompetitive basis. There are currently 172 outstanding applications for preference right leases remaining from prospecting permits issued mostly in the late 1960's and early 1970's (see Table 2-22).

Total recoverable reserves in PRLAs are 9.9 billion tons, 3.5 billion surface minable and 6.4 billion minable by underground methods. Sixty percent of PRLA reserves are located in the Powder River Coal Region, all in the Wyoming part. Seventy-three percent of Powder River Coal Region

PRLA reserves are underground reserves. The Uinta-Southwestern Utah and San Juan River Coal Regions each contain more than 1 billion tons of PRLA reserves. The Uinta reserves are mostly suitable for underground mining, whereas 55 percent of the San Juan River reserves are recoverable by surface mining methods.

Some PRLA holders may be unable to obtain leases because they have failed to meet all the legal requirements for processing their applications. Initial showings for some PRLAs were never made, or were made after the legal deadline had passed. Other PRLAs were improperly filed including areas containing prior mining claims. PRLAs also may have little development potential because they are located in areas where coal development is now considered environmentally questionable and where the Department would want to exchange for or purchase any leases which PRLA holders are rightfully due.

As part of the Department's coal policy review, all PRLAs were examined to assess compliance with filing deadlines and other legal requirements and to assess potential environmental problems. Table 2-23 shows PRLA production potential, after excluding PRLAs for which there are legal uncertainties and PRLAs in areas that are considered environmentally questionable.

Total PRLA production potential would be 251 million tons per year. However, 63 percent of this production potential is for underground mining, which has limited prospects in the next decade except in the Uinta-Southwestern Utah Coal Region. Forty-four percent of total PRLA reserves and 57 percent of PRLA reserves without legal or environmental questions are underground reserves located in the Powder River Coal Region, where DOE projections show no underground mining occurring. There are also doubts as to the desirability or feasibility of production from many PRLA surface reserves. PRLAs in many cases are located outside the areas of highest coal development potential, because the Federal government originally issued prospecting permits, which have ripened into PRLAs, only in areas which were outside the known prime coal locations. There also was little attention given to environmental considerations in the issuing of prospecting permits.

2.7.2 Coal Owned by Indian Tribes¹

Indian owned coal reserves in the west are estimated to be 70 billion tons, 30 billion of which are surface minable. These reserves constitute the largest contiguous blocks of non-Federal coal and are a very important potential source of supply for future western coal production. Coal production from Indian lands was 22.9 million tons in 1977, 13.8 percent of total western production. The largest amount of Indian coal production in 1977 took place in Arizona, 11.5 million tons. Indian coal production was 11.4 million tons in the six western Federal coal states, 6.9 million tons in New Mexico, and 4.5 million tons in Montana.

The most important Indian coal owners are the Crow and Cheyenne Tribes in the Powder River Coal Region in Montana, the Navaho Tribe in the San Juan River Coal

¹Indian coal is considered "non-Federal" coal in this environmental impact statement. This coal would not be governed by the Department's coal management program. Rather, the Department, through the Bureau of Indian

Affairs, exercises trust responsibility over coal development on Indian reservations.

TABLE 2-22
OUTSTANDING PREFERENCE RIGHT LEASE APPLICATIONS

COAL REGION	NUMBER OF APPLICATIONS	ACREAGE LEASED	RECOVERABLE SURFACE RESERVES (million tons)	RECOVERABLE UNDERGROUND RESERVES (million tons)	TOTAL RECOVERABLE RESERVES (million tons)
Fort Union					
North Dakota	0	0	0.0	0.0	0.0
Montana	<u>4</u>	<u>14,673</u>	<u>(a)</u>	<u>(a)</u>	<u>(a)</u>
Total	4	14,673	(a)	(a)	(a)
Powder River					
Montana	0	0	0.0	0.0	0.0
Wyoming	<u>60</u>	<u>96,149</u>	<u>1,604.3</u>	<u>4,308.3</u>	<u>5,912.6</u>
Total	60	96,149	1,604.3	4,308.3	5,912.6
Green River-Hams Fork					
Wyoming	14	43,401	(a)	100.5	(a)
Colorado	<u>5</u>	<u>9,130</u>	<u>(a)</u>	<u>25.0</u>	<u>(a)</u>
Total	19	52,531	25.2	125.5	150.7
Uinta-Southwestern Utah					
Utah	25	75,591	85.7	989.4	1,075.1
Colorado	<u>10</u>	<u>28,205</u>	<u>22.2</u>	<u>166.8</u>	<u>189.0</u>
Total	35	103,796	107.9	1,156.2	1,264.1
San Juan River					
New Mexico	28	77,590	(a)	(a)	(a)
Colorado	<u>2</u>	<u>3,457</u>	<u>(a)</u>	<u>(a)</u>	<u>(a)</u>
Total	30	81,047	824.3	680.0	1,504.3
Denver-Raton Mesa					
Colorado	20	42,118	670.5	80.6	751.1
New Mexico	<u>0</u>	<u>0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	20	42,118	670.5	80.6	751.1
Other Regions	4	5,954	(a)	(a)	(a)
GRAND TOTAL	172	396,268	3,540.2(b)	6,366.4(b)	9,906.6(b)

(a) Cannot be disclosed because of confidentiality.

(b) Includes Fort Union and Other Regions reserves.

TABLE 2-23
PRODUCTION POTENTIAL FROM OUTSTANDING PREFERENCE RIGHT LEASE APPLICATIONS^(a)

(million tons)

COAL REGION	TOTAL PRLA RECOVERABLE RESERVES		RECOVERABLE RESERVES WITHOUT LEGAL QUESTIONS (d)		RECOVERABLE RESERVES WITHOUT LEGAL OR ENVIRONMENTAL QUESTIONS (e)		ANNUAL PRODUCTION POTENTIAL (f)	
	SURFACE	DEEP	SURFACE	DEEP	SURFACE	DEEP	SURFACE	DEEP
Fort Union	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Powder River	1,604.3	4,308.3	1,604.3	4,308.3	1,454.0	4,308.3	48.5	143.6
Green River-Hams Fork	25.2	125.5	25.2	125.5	8.1	19.3	0.3	0.6
Uinta-Southwestern Utah	107.9	1,156.2	107.9	373.0	55.4	340.7	1.8	11.4
San Juan River	824.3	680.0	361.6	52.0	337.8	50.5	11.3	1.7
Denver-Raton Mesa	670.5	80.6	670.5	80.6	549.4	78.4	18.3	2.6
Other Regions	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
TOTAL	3,540.2 ^(b)	6,366.4 ^(b)	3,077.5 ^(b)	4,955.2 ^(b)	2,712.7 ^(b)	4,813.0 ^(b)	90.4 ^(b)	160.4 ^(b)

(a) Cannot be disclosed because of confidentiality requirements.

(b) Includes Fort Union and Other Regions.

(c) Estimates based on 1978 Department review of Preference Right Lease Applications.

(d) Eliminates reserves under applications which have not met Department procedural or legal requirements -- initial showings not made, or filed past deadline, or the PRLA was filed for land already subject to a mining claim.

(e) Eliminates both PRLA reserves with legal problems and reserves which lie in areas judged by Department personnel to be environmentally questionable for mining.

(f) Based on estimates of reserves without legal or environmental questions. Assumes a 30-year mine life.

Region and the Three Affiliated Tribes in the Fort Union Coal Region. Except for the Cheyenne, these tribes have indicated an interest in developing their coal reserves. Coal development has the potential for generating a major infusion of income for these tribes. At present, development of the Crow coal is being delayed by a legal battle between the tribe and previous purchasers of leases and holders of prospecting permits.

In Table 2-24, estimates of currently economic surface minable reserves owned by Indian tribes are shown. The 1977 production level, 1985 planned production from existing and proposed mines, and maximum production potential on Indian lands are also shown. Planned production for 1985 from Indian lands in the six western Federal coal states is 25 million tons. Maximum production potential would be more than 800 million tons per year. However, it would be extremely unlikely that anything like full maximum potential production would occur at any one time.

2.7.3 Non-Federal, Non-Indian Coal

In addition to coal owned by Indian tribes, there are other substantial holdings of non-Federal coal in the West. The states have large reserve holdings, although typically scattered in isolated state sections. Railroads retain large holdings of coal in checkerboard areas which were originally railroad land grants. The Federal Government did not make it a general practice to retain coal rights in its land disposals until the early twentieth century, resulting in large-scale transfers of coal ownership to the private sector in earlier years. In Table 2-25, estimated non-Federal coal reserves and the percentage of total reserves they represent (excluding Indian coal) are shown for the western coal regions. In the six regions shown, non-Federal reserves are 28 percent of total reserves.

State governments have made large amounts of coal available for development through state leasing. States have issued 2,553 outstanding coal leases for 2.2 million acres of land, almost three times the Federal acreage currently under lease (see Table 2-26). The State of Wyoming has issued the largest number of leases for more than 1 million acres of state-owned coal. Little production has thus far come from state leases (see Table 2-26), partly due to their small sizes and scattered locations. State leases are most likely to be developed in the future when state coal is located amidst or adjacent to Federal or private coal that is being developed.

Although there are substantial non-Federal reserves, the development potential of these reserves generally is limited by the highly fragmented coal ownership pattern in the West. In checkerboard areas, for example, development would have to proceed one section at a time if the intervening Federal sections were not available. This would impose a high economic cost and would also have undesirable environmental consequences. Therefore, non-Federal coal in checkerboard areas would have a poor development potential without the addition of Federal coal (and vice-versa).

In order to assess the development potential of non-Federal reserves by themselves, these reserves were classified according to three categories: (1) blocks of non-Federal coal possibly large enough by themselves to support a viable mining operation (with the minimum cutoff size set at 2,560

acres); (2) non-Federal coal in checkerboard areas and probably not developable alone; and (3) non-Federal coal in scattered parcels probably too small to support a viable mining operation (less than 2,560 acres). The estimated distribution of non-Federal reserves among these three categories is shown in Table 2-27. Checkerboard areas alone contain more than one-third of all non-Federal reserves. In total, 55 percent of all non-Federal reserves are in fragmented parcels too small to be developed by themselves.

The regions with the highest percentages of non-Federal reserves in large contiguous blocks are the Fort Union, Green River - Hams Fork, and Denver-Raton Mesa Coal Regions. The Uinta-Southwestern Utah and the Powder River Coal Regions have relatively much smaller proportions of non-Federal coal contained in large blocks.

Because of the importance of the Powder River Coal Region in future coal production projections, ownership patterns in this region are particularly significant. In the Wyoming part of the region, the areas along the Wyodak seam which are surface minable and which have the highest coal development potential contain almost entirely Federally-owned coal. Other than Indian coal, the Montana part of the Powder River Coal Region is composed of a large checkerboard area and a large area of Federally-owned coal. Only 6.8 percent of the Powder River Coal Region reserves are non-Federal and appear possibly large enough to be efficiently developed.

Most of the coal included in the "possibly developable" category in Table 2-27 is in fact not likely to be developed in the near future. Much of the non-Federal coal is outside the areas of lowest production costs. A large part is suitable only for underground mining. The alluvial valleys of the West are typically privately owned and contain sizeable non-Federal reserves which it may not be desirable to develop. Non-Federal reserves may also have other environmental problems. Even though non-Federal blocks may be of sufficient size to form a viable mining unit, these blocks may have several different non-Federal owners. There is no assurance that all owners would want their coal developed or that it would be possible to assemble the non-Federal coal into a developable package. Finally, non-Federal coal owners may not be able to gain surface owner consent in those cases where there is a different surface owner and consent is needed under state law.

Planned production from mine plans that included Federal leases was shown earlier in Table 2-20. There are also a number of planned mines which do not involve any Federal coal. In 1977, excluding Indian lands, mines with no Federal coal produced 10.7 million tons, or 9 percent of total production in the six western Federal coal states.

In Table 2-28, production planned for 1985 from mines that do not involve any Federal leases is shown for the six western coal regions. Total 1985 production planned from these mines is 35.7 million tons. Forty-five percent of this planned production would occur in the Fort Union Coal Region, where there is extensive non-Federal coal ownership.

TABLE 2-24

INDIAN COAL RESERVES AND PRODUCTION PLANS, SIX WESTERN FEDERAL COAL STATES

COAL REGION	SURFACE MINABLE RESERVES ^(a) (million tons)	1977 PRODUCTION	1985 PLANNED PRODUCTION FROM EXISTING AND PLANNED MINES ^(b) (million tons/year)	MAXIMUM ANNUAL PRODUCTION POTENTIAL ^(c) (millions of tons) ^(c)
Fort Union ^(d)	3,000	0	0	100
Powder River ^(e)	15,000	4.5	14.0	500
San Juan River ^(f)	4,000	6.9	11.1	133
Other Indian holdings ^(g)	5,000-7,000	0	0	166-233

(a) Recoverable reserve estimates from Bureau of Indian Affairs Minerals Inventory Reports.

(b) Based on DOE Leasing Policy Development Office projections of productions in 1985 (Reference Number 13).

(c) Assumes 30-year mine life.

(d) Coal owned by Three Affiliated Tribes

(e) Coal owned by Crow and Cheyenne Tribes.

(f) Coal owned by Navaho Tribe, includes only New Mexico reserves. The Navaho tribe also owns another 1 billion tons of surface reserves in Arizona.

(g) Includes coal owned by Southern Ute, Ute Mountain, Jicarilla, Flathead, and Blackfeet tribes.

TABLE 2-25

ESTIMATED NON-FEDERAL RESERVES

COAL REGION	NON-FEDERAL RESERVES AS PERCENT OF ALL RESERVES ^(a)	ESTIMATED NON-FEDERAL RESERVES (million tons) ^(b)	MAXIMUM ANNUAL PRODUCTION POTENTIAL (millions of tons) ^(c)
Fort Union	61%	14,092	470
Powder River	20	28,505	950
Green River-Hams Fork	44	6,839	228
Uinta - Southwestern Utah	17	1,014	34
San Juan River	23	958	32
Denver-Raton Mesa	<u>82</u>	<u>3,169</u>	<u>106</u>
Total	28	54,577	1,820

(a) Breakdown between Federal and non-federal ownership made by examination of coal ownership rights in the six regions. Reserves are assumed to be distributed between Federal and non-federal ownership in direct proportion to the acreages of Federal and non-federal sub-surface coal ownership within Known Recoverable Coal Resource Areas (KRCRAs) located in each region. Estimates were made under 1978 Interior Department coal policy review study of coal ownership, as shown on BLM surface-subsurface minerals ownership maps ("color quads"). Data do not include Indian-owned coal.

(b) Estimates based on Bureau of Mines reserve figures (see Table 2-1) (Reference numbers 2, 3.

(c) Assumes 30-year mine life.

TABLE 2-26
STATE COAL LEASES

STATE	LEASES (No.)	ACREAGE LEASED (Acres)	1977 PRODUCTION (millions of tons)
Colorado	147	252,199	0.2
Montana	96	51,947	5.1
New Mexico	218	106,860	0
North Dakota	10	3,838	1.3
Utah	514	543,557	0.3
Wyoming	1,568	1,235,229	0.7
TOTAL	<u>2,553</u>	<u>2,193,630</u>	<u>7.6</u>

Source: Reference Number 14.

TABLE 2-27

ESTIMATED DISTRIBUTION OF NON-FEDERAL RESERVES
BY OWNERSHIP CATEGORIES^(a)
(Percent)

COAL REGION	SOLID NON-FEDERAL RESERVES (POSSIBLY DEVELOPABLE) ^(b)	NON-FEDERAL RESERVES IN CHECKERBOARD	NON-FEDERAL RESERVES IN SCATTERED SMALL BLOCKS ^(c)	FEDERAL RESERVES
Fort Union	37.8%	21.6%	1.7%	39%
Powder River	6.8	7.9	5.5	79.8
Green River- Hams Fork	23.3	13.4	7.0	56.3
Uinta-Southwestern Utah	6.9	0	10.1	82.9
San Juan River	14.2	0	8.5	77.3
Denver-Raton Mesa	62.8	0	19.5	17.8
TOTAL	12.1	9.3	5.6	73.0

(a) Estimates based on the distribution of subsurface coal ownership in Known Recoverable Coal Resource Areas (KRCRA's) in the regions shown.

(b) Solid ownership was defined as reserves under nonfederal ownership in contiguous blocks greater than or equal to 2,560 acres. In Regions 2 and 3, a portion of the reserves are found in areas of checkerboard ownership, within which a number of 5-section blocks (3,200 acres) exist where the center section is state-owned and the surrounding sections are privately owned. These sections may be developable only if the center section (640 acres) is leased by the state to a private owner holding development rights to the reserves in the surrounding sections. In Region 2, at least 55 percent of the total solid nonFederal block is composed of these five-section blocks; in Region 3, at least 34 percent of the total solid nonFederal blocks fall in this category.

(c) Scattered small ownership blocks are defined as isolated sections of nonFederal coal ownership less than 2,560 acres in size, outside checkerboard areas.

TABLE 2-28

1985 PLANNED PRODUCTION FROM EXISTING AND PLANNED MINING
OPERATIONS INVOLVING ONLY NON-FEDERAL, NON INDIAN COAL(a)

REGION	1985 PLANNED PRODUCTION (million tons/year)
Fort Union	15.9
Powder River	3.6
Green River-Hams Fork	6.9
Uinta - Southwestern Utah	3.9
San Juan River	2.4
Denver-Raton Mesa	3.0
Total	35.7

(a) Based on DOE Leasing Policy Development Office compilations of planned mine production in 1985 (Reference Number 13).

2.8 THE NEED FOR NEW FEDERAL COAL LEASING

The Department of the Interior imposed a moratorium on further leasing of Federal coal in 1971 (see Chapter 1). At that time, a Department study indicated that Federal reserves under lease were rising rapidly, while production of Federal coal was remaining at low levels. Most previous acquisitions of Federal leases appeared to have been largely for speculative purposes.

Subsequent efforts by the Department to resume Federal coal leasing, including the decision in 1973 to develop a leasing program and the adoption of a leasing program in 1976, were widely criticized on the grounds that the need to resume Federal leasing had not been demonstrated. The failure of the Department to show the need for leasing was cited by the court in *NRDC v. Hughes* as a principal defect in the previous coal leasing programmatic environmental impact statement.

Resumption of Federal coal leasing would have a number of both beneficial and adverse impacts. If the Secretary of the Interior decides to resume leasing, his decision would reflect a determination that the need for leasing and the associated benefits outweigh the adverse impacts.

Resuming leasing gives the Nation four important benefits:

- The most important benefit is that it would give the Nation greater assurance of being able to meet its national energy objectives.
- New leasing would also provide a means to promote a more desirable pattern of coal development. It may be possible to reduce the adverse environmental impacts resulting from coal mining by altering coal development patterns.
- A resumption of leasing offers significant legal and administrative advantages for the Department of the Interior.
- Finally, the state of competition in the western coal industry would be improved by new leasing.

These benefits must be weighed against adverse environmental consequences of new leasing which are analyzed in Chapter 5.

2.8.1 Leasing to Meet National Energy Objectives

In leasing to meet national energy objectives, the Department is not leasing to meet today's needs but those many years in the future. Forecasts of future energy demands and supplies are subject to many uncertainties. The uncertainties increase the further in the future the forecast is made. It is difficult to predict how energy users and suppliers would respond to greater energy scarcity, new energy and environmental legislation, and changing energy prices, or to what extent would users adopt conservation measures or be willing to change their previous behavior patterns. Information about current and expected future energy reserves often is not very accurate or reliable. Changes in technology may substantially alter the relative economics of different energy sources. The most important factor determining coal demand, electric power demand, is itself subject to great uncertainty. Changes in government regulations can also cause important shifts in the relative

desirability of one energy source compared with another. For these and other reasons, when examining the need for western coal it is important to examine a range of possible demand and supply levels, as was done by the Department of Energy (DOE) in the generation of high, medium, and low western coal production projections.

Consideration of forecasts for a range of future years is also required in energy planning. Thus, in evaluating the need for new Federal leasing, western coal production forecasts for 1985 and 1990 were prepared.

After a lease is issued, it would typically be another 1 to 3 years before a mine plan is submitted to the government. A government decision on approval of the plan is likely to take up to another year, and in some cases more. From the point of approval, 2 to 3 years would then be required to get a major western surface coal mine into full operation. All told, actual production of coal appears likely to occur 4 to 7 years after the sale is held and a lease is issued.

At each of these steps, the potential coal mine could be found infeasible and have to be abandoned because of environmental, geologic, or economic factors. Thus, not only the uncertainty surrounding future levels of demand, but also the uncertainty of any given tract passing through the steps from potential tract to fully operational mine must be taken into account in assessing leasing needs.

If the decision is made to resume Federal leasing, about 1 to 2 years would be required to accomplish the full land use and environmental planning for the first round of lease sales under the preferred program. (Some earlier sales could be held under special start-up procedures and later sales would be able to utilize the planning for the first sales.) Taking into account the time after lease issuance, a decision in 1980 to hold a lease sale is not likely to result in coal production before 1985 to 1990. The planning horizon for this programmatic environmental impact statement includes decisions on whether or not to lease up to as late as 1985. A decision in 1985 to hold a lease sale is not likely to result in coal production until the early 1990s and possibly as late as 1995. Hence, the time horizon for a current assessment of the need for a resumption of Federal coal leasing extends as far as meeting coal production needs in 1995. DOE did not make production projections beyond 1990 and such distant projections would be subject to many uncertainties. The primary focus in assessing leasing needs is on the year 1990. It is unlikely that Federal leasing decisions following completion of this programmatic environmental impact statement could, or need to, have a major influence on 1985 western coal production levels.

Under current regulations, existing Federal leases issued prior to 1976 and not in production by 1986 would be subject to cancellation for failure to be diligently developed. It is expected that, with a few possible exceptions (see 43 CFR 3520.2-5), existing leases not producing in 1986 would in fact be cancelled. Hence, increases in production of Federal coal after 1986 would essentially have to come either from new Federal leasing or from expansion of mines containing Federal coal which are already operating by 1986. It is hard to know precisely what the expansion potential of these mines would be, or whether rapid expansion would introduce inefficiencies in their operation. But beyond this expansion potential, if Federal coal is to have a role in increases in

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western coal production after 1986, it would have to be through development of Federal coal that is not now under lease.

In section 2.7 above, estimates were made of planned and likely western production in 1985 from a number of possible sources. Table 2-29 summarizes these estimates. Total planned production in Table 2-29 includes: (1) planned production from non-Federal, non-Indian mines which do not involve any existing Federal leases; (2) planned production from Federal mine plans currently approved or submitted to the Department; and (3) planned production from mines on Indian lands. Production already planned for 1985 from these sources is 365 million tons. This estimate is reasonably consistent with estimates of 1985 planned production within the six coal regions in Table 2-29 previously compiled by the National Coal Association and DOE's Leasing Policy Development Office. The 1985 planned production estimates obtained by these sources were 420 million tons and 357 million tons, respectively. For comparison, total production in the six coal regions in 1977 was 118 million tons.

As seen in Table 2-29, planned 1985 production is more than the DOE low projection for 1985 of 300 million tons for the six regions located in the six western Federal coal states. On the other hand, planned production is less than the 1985 medium and high production projections of 391 million tons and 439 million tons, respectively.

The addition of likely 1985 production from existing leases currently without mine plans brings the total for 1985 planned and likely production to 422 million tons, above the medium 1985 DOE projection, although still below the high DOE 1985 projection.

As seen in Table 2-29, achievement of any of the DOE 1985 projected production levels appears unlikely in the Green River-Hams Fork Coal Region. The total of already planned production and likely production from existing leases without mine plans in this region is only half the DOE medium 1985 projected production. The Green River-Hams Fork Coal Region is the only region in which achieving 1985 DOE projected production levels appears to be a substantial problem.

For 1990, which is the more important year than 1985 in assessing the need for new Federal leasing, currently planned production is less than the DOE low, medium, or high projected production levels (see Table 2-30). However, for low 1990 projections, which are actually less than the medium 1985 projections, planned production is just short of projected production. With the addition of likely production from existing Federal leases not now included in mine plans, there would appear to be little difficulty in achieving the DOE low 1990 projected production levels without further Federal leasing if all planned production materializes. As is the case for 1985, there would be major problems in reaching any of the projected production levels in one region, the Green River-Hams Fork Coal Region.

The fact that currently planned and likely production exceeds 1990 low production projections does not resolve the question of the need for new leasing in the low case. Current company production plans are based on demand assumptions that in many cases are undoubtedly more optimistic than the assumptions used by DOE for the low projections. If DOE low assumptions prove accurate, some part of currently planned

production would very likely not occur. There would not be enough demand by 1985 to support it, which is the time frame toward which most current plans are oriented. If the planned production does not occur by 1986, plans based on mining of Federal leases would have to be abandoned entirely because of failure to meet diligent development requirements.

Even under low demand assumptions, increases in western coal production would be expected between 1986 and 1990. Significant contributions to this growth in production could not come from Federal coal without new leasing because undeveloped leases would in all likelihood have already been cancelled. In short, the only forecast that leads to a wholly unambiguous conclusion that there is no need for new leasing is achievement of 1985 medium or high production projections, followed by a sharp downturn in demand resulting in little if any further increases in production to 1990. If low projections are realized in 1985 as well as 1990, production increases would still be needed between 1985 and 1990 and the only way for Federal coal to make a major contribution to these increases would be through new leasing in the 1980 to 1983 time frame.

Unlike the low 1990 case, currently planned production is far less than the DOE medium 1990 projected production of 660 million tons. The addition of likely production from existing Federal leases without mine plans does little to alter this conclusion. The only regions which would be able to meet 1990 DOE medium projections from currently expected production are the Fort Union and Uinta-Southwestern Utah Coal Regions. These regions have only 7 percent of 1990 medium production. The Powder River Coal Region has expected production totaling 226 million tons, far less than the DOE medium 1990 projected production of 396 million tons.

To achieve the DOE 1990 high production projections for all western regions of 922 million tons would require a level of production more than two and one half times currently planned 1985 production. In the Powder River Coal Region, the 1990 high projection is 603 million tons, compared with 219 million tons in planned production. Planned production is less than the 1990 high projection in all regions except the Uinta-Southwestern Utah Coal Region.

There is not a great likelihood that western coal production would actually reach DOE's high projected levels in 1990. However, the high 1990 production projection represents a reasonable approximation of medium production projections for 1995. Although DOE did not prepare 1995 projections for the purposes of this statement, such projections have been made in the course of other studies. In making an assessment of the need to resume Federal leasing, as indicated above, the time horizon extends beyond 1990 to consideration of coal requirements expected as late as 1995.

It is unlikely that many PRLAs could be processed, leases issued, and production begun from these leases by 1985. The production potential of PRLAs is of importance mainly in considering 1990 production projections. In Table 2-30, production potential of PRLA surface minable reserves is shown. Because western mining is expected to be almost entirely surface mining except in the Uinta-Southwestern Utah Coal Region, underground PRLA reserves are likely to make an insignificant contribution to reaching 1990 production projections other than in this region. In the Uinta-Southwestern Utah Coal Region, there appears to be little

TABLE 2-29
SUMMARY OF PLANNED AND PROJECTED PRODUCTION, 1985
(million tons)

COAL REGION	TOTAL 1985 PLANNED PRODUCTION (a)	LIKELY PRODUCTION FROM EXISTING LEASES WITHOUT MINE PLANS (b)	TOTAL PLANNED AND LIKELY PRODUCTION	1985 DOE PROJECTIONS		
				LOW PROJECTION	MEDIUM PROJECTION	HIGH PROJECTION
Fort Union	21.8	(c)	21.8(d)	18.4	20.0	23.4
Powder River	219.1	7.0	226.1	140.4	204.6	232.1
Green River-Hams Fork	49.8	6.8	56.6	89.9	112.0	128.8
Uinta - Southwestern Utah	47.2	23.3	70.5	25.7	26.4	26.3
San Juan River	24.0	8.5	32.5	20.1	22.8	22.9
Denver-Raton Mesa	3.0	(c)	3.0(d)	5.3	5.3	5.2
TOTALS	364.9	57.3(e)	422.2(e)	299.8	391.1	438.7

(a) Includes planned production for mine plans including Federal leases (Table 2-18), planned production from Indian Lands (Table 2-21) and planned production from wholly non-Federal mines (Table 2-24).

(b) See Table 2-19.

(c) Cannot be disclosed because of confidentiality requirements.

(d) Does not include likely production.

(e) Total includes likely production in Fort Union and Denver-Raton Mesa Coal Regions that is not disclosed on a regional basis.

Source: Reference Number 13.

TABLE 2-30
SUMMARY OF PLANNED, POTENTIAL, AND PROJECTED PRODUCTION, 1990

(million tons)								
COAL REGION	TOTAL 1985 PLANNED PRODUCTION (b)	LIKELY PRODUCTION FROM EXISTING LEASES WITHOUT MINE PLANS (b)	TOTAL PLANNED AND LIKELY PRODUCTION	PRODUCTION POTENTIAL PRLA SURFACE RESERVES (c)	TOTAL PRODUCTION POTENTIAL	1990 DOE PROJECTIONS		
						LOW	MEDIUM	HIGH
Fort Union	21.8	(d)	21.8 ^(e)	(d)	41.5(g)	21.9	20.6	34.5
Powder River	219.1	7.0	226.1	48.5	274.6	173.7	396.1	602.9
Green River-Hams Fork	49.3	6.8	56.1	0.3	56.4	105.9	149.5	177.7
Uinta-Southwestern Utah	44.8	23.3	68.1	1.8	69.9	25.1	28.3	27.9
San Juan River	24.0	8.5	32.5	11.3	43.8	34.5	58.4	72.5
Denver-Raton Mesa	3.0	(d)	3.0 ^(e)	(d)	23.6(g)	5.4	6.8	6.6
TOTALS	362.0	57.3 ^(f)	419.3 ^(f)	90.5	509.8 ^(f)	366.5	659.7	922.1

(a) Includes planned production for mine plans including Federal leases (Table 2-18), planned production from Indian lands (Table 2-21) and planned production from wholly non-Federal mines (Table 2-24).

(b) Figures obtained from Table 2-19.

(c) Figures obtained from Table 2-20.

(d) Cannot be disclosed because of confidentiality requirements.

(e) Does not include likely production.

(f) Total includes likely production in the Fort Union and Denver-Raton Mesa Coal Regions that is not disclosed on a regional basis.

(g) Total includes likely production & PRLA surface production potential.

Source: Reference Number 13.

problem in reaching any of the DOE projected production levels.

The addition of PRLA production potential provides a source of new Federal coal development between 1986 and 1990, when current Federal leases either would have already been developed or would have been cancelled. This potential production could play a key role if new Federal coal production is needed during this period to meet 1990 low production projections. Issuance of preference right leases would still leave total production potential from already indicated sources far below medium and high 1990 projected production. Only in the less critical Fort Union and Denver-Raton Mesa Coal Regions does the addition of PRLA production potential raise total production potential above the 1990 medium or high projected production.

An assessment of the need for new Federal leasing based on projections of demand and supply levels thus does not produce an unambiguous picture. For 1985, there appears to be little need for new leasing, except in one region, the Green River-Hams Fork Coal Region. For 1990, there could be some, but probably not a large, need for new leasing to reach low projected production levels. On the other hand, achievement of medium and high 1990 production levels would require extensive development of new sources of western coal production, especially in the Powder River, Green River-Hams Fork, and San Juan River Coal Regions. Because more than 70 percent of the coal in the six western Federal coal states is owned by the Federal Government, new Federal leasing would make a major contribution in achieving such development.

The absolute need for new leasing to meet national energy objectives thus depends on which assumptions about future energy demands and the role of western coal in supplying those demands materialize. Uncertainty also exists about planned production estimates. How assured is production currently planned or considered likely and how much production in fact is likely to occur but may not have been included in planned production estimates? Since it is impossible to know at this time which assumptions and estimates are actually correct, government policy must be flexible. An assessment must be made of the costs of leasing too much Federal coal if current need estimates prove too high, versus the costs of leasing too little Federal coal if higher estimates should turn out to be more valid.

In the past, the cost of leasing too much Federal coal has been to fail to obtain full value for the Federal coal, while also rewarding speculative behavior. Without effective enforcement of diligent development requirements, purchasers of Federal coal leases could hold on to these leases for long periods without developing them. Because expected development was still far off and still uncertain, sales of leases did not obtain prices commensurate with the leases' later development values. Moreover, the Federal Government lost control over the land use and environmental impacts of Federal coal development because the location and timing of such development became largely a matter for private initiative.

These problems would still exist in the future, although in somewhat moderated form, if the Federal government were to lease too much coal in relation to need. Strict enforcement of diligent development requirements, mandated under the

Federal Coal Leasing Amendments Act of 1976, would prevent any future speculative holding of leases for long periods. However, issuance of more leases than can be developed would still act to depress lease sale prices because of the resulting uncertainty about development prospects within the allowed diligent development period. Although more leases would be sold, the lowered prices per lease would probably more than compensate, resulting in reduced overall leasing revenues. The land use and environmental impacts of Federal leasing would depend on which of the excess number of issued leases are developed, making Federal control of these impacts less secure. Finally, a new problem would be introduced, in that strict enforcement of diligent development requirements might cause significant distortions and inefficiencies if many leases were threatened with cancellation. Coal companies might rush leases into production prematurely, offering high discounts and realigning coal shipments to find a place to ship the early production from the leases.

In considering the possibility of overleasing, it should be recognized that the amount of Federal coal offered is not necessarily the same as the amount actually leased. Fair market value requirements are likely to allow operators, especially the more efficient ones, a certain degree of leeway in their bid levels, but nevertheless would act to discourage marginal operators from acquiring tracts without sound market prospects. By insisting on full fair market value, the Federal government could end up offering many more leases than are actually issued if there is not much demand. To some extent, the fair market value requirement thus acts as a barrier minimizing the risk of the government leasing amounts of coal greatly in excess of market requirements.

The principal consequences of leasing less Federal coal than is needed to meet national energy objectives would likely be to alter patterns of coal development, both at national and regional levels. At least on the basis of computer projections, it appears improbable that total national coal production would be greatly reduced.

2.8.2 Leasing to Promote More Desirable Patterns of Coal Development

The fact that currently planned and likely production, together with the production potential from PRLAs, is not sufficient to reach medium and high 1990 DOE production projections does not mean that these projected levels could not be attained without new Federal coal leasing. As shown in Tables 2-24 and 2-25, there are large amounts of Indian and other non-Federal coal reserves in western regions sufficient to meet almost any conceivable 1990 production requirements.

It is probably not desirable or feasible to emphasize development of this non-Federal coal. Large amounts of it have high production and environmental costs, due to uneconomically small parcel sizes (see Table 2-27), high stripping ratios, distances from transportation, and many other factors. Non-Federal underground coal reserves are not likely to make much of a contribution to western coal for some time, since most western coal is expected to be surface mined. Non-Federal coal is of varying quality, some of it having less desirable chemical composition or a low heat

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content. The large supplies of non-Federal lignite in the Fort Union Coal Region, for example, would not see rapid development without a major expansion in coal use for gasification and liquifaction. Some non-Federal coal is located in less environmentally desirable locations such as alluvial valleys, which were the first areas to be acquired by early settlers. Indian tribes may oppose major coal development on their reservations or choose to develop their coal gradually over a lengthy period. Private surface owners above non-Federal coal may refuse consent under state surface owner consent laws or owners of non-Federal coal simply may not want to develop it at this time.

The difficulty of relying on non-Federal coal for expanded future production varies from region to region (see tables 2-27 and 2-28). In the Powder River Coal Region, there is not much potential for production of non-Federal coal alone. In the Wyoming part of the Powder River Coal Region, the high quality, surface minable reserves are almost entirely Federally owned. In the Montana part, the better quality coal is divided among areas of solid Federal ownership, checkerboard ownership, and Indian ownership. It would be difficult to develop non-Federal coal in checkerboard areas without new Federal leasing. The Indian coal reserves would be sufficient for a large expansion of non-Federal coal production (see Table 2-24). However, the Cheyenne tribe does not currently favor development of its coal reserves and there are many uncertainties about the future development of coal owned by the Crow tribe.

The Green River-Hams Fork Coal Region contains a large checkerboard area in Wyoming in which expanded production beyond planned levels would be difficult without new Federal leasing. Because coal in the Uinta-Southwestern Utah Coal Region is largely owned by the Federal Government, this region is also relatively more dependent on Federal leasing for expanded production beyond already planned or committed levels. On the other hand, there are major holdings of non-Federal coal which could be developed without Federal leasing in the Fort Union Coal Region. The Denver-Raton Mesa Coal Region similarly has extensive non-Federal deposits. The San Juan River Coal Region appears somewhat less dependent on new Federal leasing because of the presence of Indian coal and some substantial blocks of developable non-Federal coal.

A decision by the Federal Government not to lease Federal coal could have a number of impacts on future patterns of coal development. Production might simply be shifted from Federal to non-Federal coal within each region. The western regions more dependent on Federal leasing, especially the Powder River Coal Region, could experience declines in production which are displaced to other western regions less dependent on new Federal leasing, although a similar level of coal development might result in the West as a whole. It is also possible that western coal production would decline significantly, eastern production would rise correspondingly, and there would be little change in overall national coal production. Finally, there could be some declines in total national coal production, with the losses made up either by greater national energy conservation or by greater production from other energy sources.

It is impossible to predict with great confidence to what extent these possibilities would actually materialize. However,

it appears that if there were no further leasing of Federal coal by 1990 there would probably be a significant decline in coal production below medium and high DOE projected levels from the Powder River Coal Region in Wyoming and Montana. This could be avoided only by large scale increases in production from Indian lands in that region. Less dramatic declines below projected levels would probably be experienced in the Green River-Hams Fork Coal Region. In other regions, production would be more likely to be displaced from Federal to non-Federal lands within the region, or there would be already adequate production potential for 1990 from mines — some including Federal leases — currently producing or expected to be producing.

If new production within a given region is forced to take place on the more limited non-Federal lands, it becomes likely, although it does not have to be the case, that some non-Federal sites would be devoted to coal production that are inferior to unleased Federal sites in their environmental and economic suitability for coal mining. Simply because the universe of sites to select from would be much smaller, one would automatically expect that it would be harder to find non-Federal sites with the lowest environmental and economic costs. Historically, purchasers of Federal lands and settlers under the Homestead Acts naturally gravitated toward the better and more productive lands, leaving the remaining, least wanted lands to become the public domain. Because of this, non-Federal lands are more likely to be used for farming or urban purposes and generally would have a higher current use value and thus a higher opportunity cost for coal mining.

If Federal coal is not available within a region, mines of inefficient sizes and configurations would likely have to be formed from non-Federal coal alone. For example, in areas of checkerboard ownership, pressures would be generated for development of the alternating non-Federal sections and of the 5-section non-Federal blocks centered on state sections. If such development occurred, the normal pattern of mining would be distorted, mining costs would increase, and it generally would not represent the most efficient or environmentally satisfactory pattern of coal mining.

Without new Federal leasing, inefficient development patterns could also result from bypassing of unleased Federal tracts which lie in the path of ongoing mining operations (operating on existing Federal leases or non-Federal lands). Because it would usually be easy for an existing operation to mine a tract in its path, the bypassing of such coal foregoes the opportunity to produce relatively low cost coal. The coal bypassed would then generally be uneconomical to produce and would effectively be wasted.

If Federal coal is not available, some existing operations would very likely have to shut down because they could not obtain needed coal. In addition to being socially disruptive, this result might well cause coal development to move elsewhere in the region at higher cost and, by requiring new roads and other mining facilities and new housing and public services, increase the overall area in the region adversely affected by coal mining.

New Federal leasing would be expected to displace development of some existing leases and PRLAs. Existing leases were issued with a minimum of attention to land use planning and environmental considerations. The locations of PRLAs similarly reflect an absence of planning. Displacement

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of coal development from the sites of existing leases and PRLAs to sites of new Federal leases which would be established comprehensive land use and environmental planning almost certainly would result in an economically and environmentally improved pattern of development within a region.

A decision not to lease Federal coal would alter development patterns by significantly increasing the pressure to develop Indian lands, offering both potential benefits and costs of coal development to Indian tribes.

If Federal coal is unavailable, interregional shifts in coal development patterns, as well as intraregional shifts, would be expected to occur. The resulting altered pattern of coal development would have different environmental consequences and would represent a different interregional economic efficiency in coal production. For example, because of the unusual thickness of Powder River coal seams, on average more than 5 acres of land in the East and 3.5 acres in the Southwest would need to be mined and reclaimed in order to obtain the same amount of coal that could be obtained from one acre of land in the Powder River Coal Region. On the other hand, expanded production in the Denver - Raton Mesa Coal Region would minimize socioeconomic impacts, because this region, alone among the western regions, already has a large population with a highly capitalized public service base in place.

A decision not to lease could also result in somewhat less total coal production for the Nation. If national energy use is not correspondingly reduced, there would be greater demands on nuclear power, oil imports, and other energy sources. The foreign trade balance would be adversely affected by increasing oil imports and possibly by reducing coal exports. The resulting overall national pattern of energy development may be less efficient and environmentally desirable than would occur with new Federal leasing.

The discussion thus far has been qualitative. For some of the effects of Federal leasing on development patterns, there is little possibility of making precise quantitative estimates of their magnitude. It would be very difficult, for example, to predict how many bypass situations involving a need for Federal coal might arise or how many existing operations might have to shut down for lack of Federal coal. Shifts within regions to non-Federal coal if Federal coal would not be not available are also very hard to predict. The precise manner in which such shifts would occur would depend on many site specific considerations and the particular requirements of proposed mines. This programmatic environmental impact statement does not attempt to predict exactly how intraregional shifts from Federal to non-Federal coal would occur without new Federal leasing or what the precise effects within a region would be on coal production costs and environmental impacts. An analysis of this nature would require a detailed examination of each region which is more appropriate to land use planning and an environmental impact statement at the regional level. Future Department regional lease sale environmental impact statements would closely examine intraregional impacts of Federal leasing actions.

In general, however, the clear expectation is that new Federal leasing would improve intraregional patterns of development. New leasing will be undertaken only after

comprehensive land use and environmental planning is conducted. The much greater availability of lands for development, if Federal coal is available, offers much greater scope for finding the least costly and least environmentally damaging sites for coal development.

In keeping with its focus on interregional concerns, this programmatic environmental impact statement assesses the consequences of Federal coal management policy for the interregional pattern of coal development. In Chapter 5, estimates are shown of coal production in each region under different Federal coal management policies including no new leasing. The environmental impacts of different interregional production patterns are analyzed. New Federal leasing may be needed if interregional patterns of coal development which result under a policy to resume leasing are judged to be preferable to those which would result if no leasing occurred.

2.8.3 Leasing for Legal and Administrative Purposes

The Department has little choice legally but to process PRLAs and, for those applicants able to show commercial quantities of coal under appropriate environmental controls, either to issue a lease or to offer an exchange, purchase, or other suitable compensation. A resumption of Federal leasing, at least to the extent of issuing leases for appropriate PRLAs thus appears necessary. A formal leasing program would be required at a minimum to process the PRLAs, conduct land use planning that is statutorily mandated before leases can be issued, assess environmental impacts of PRLA leasing, and consider whether exchange, purchase, displacement through new competitive leasing or other approaches are most appropriate for dealing with environmentally unsatisfactory PRLAs.

As part of its preferred coal management program, the Department would take steps such as exchange or purchase to prevent development of existing leases as well as PRLAs in environmentally unsuitable areas. As has been mentioned, many existing leases and PRLAs were granted without much attention to their environmental impacts. The pressures for development of both existing leases and PRLAs would be heightened if new Federal leasing does not take place. The likely administrative and financial burdens on the Department to acquire leases in unsuitable areas could therefore be reduced by new leasing.

Federal and state governments would benefit from the added bonuses and royalties which could be obtained from sales of new Federal leases. The Federal Government is under no obligation to preserve private rents and profits by refraining from making alternative Federal coal supplies available to the market.

2.8.4 Leasing to Increase Competition in the Coal Industry

There are certain conditions which must exist in order for private markets to function in the most socially beneficial manner, making the best coal available at the lowest prices. A particularly critical requirement is that there should be a sufficient number of buyers and sellers that the markets are genuinely competitive and that no one or few buyers can influence prices in a monopolistic fashion.

A decision not to lease Federal coal would tend to inhibit competition in the western coal industry. Coal purchasers would have to obtain coal from those companies holding existing Federal leases or possessing non-Federal sources. In regions such as the Powder River Coal Region, where the great majority of mining sites are dependent on the availability of Federal coal, new entry into coal mining could be achieved only by purchases of already existing leases from their current holders. Because of such considerations, the Antitrust Division of the Justice Department, in a 1978 report Competition in the Coal Industry [15], recommended resumption of Federal leasing to promote greater competition in the western coal industry. The report concluded that: "Resumption of the Federal leasing program with all deliberate speed will have beneficial competitive effects."

2.9 OVERVIEW OF THE NEED FOR A FEDERAL COAL MANAGEMENT PROGRAM

The Federal Coal Leasing Amendments Act of 1976, and other recent legislation for the public lands, lay a legal and policy foundation for the Department of the Interior's management of coal owned by the United States Government. The Act expresses the intent of the Congress that, through a process of competitive lease sales, Federally owned coal be sold for a fair price from the public domain to coal operators at a rate meeting market needs for new supplies.

The President, in his Environmental Message of 1977 [12], directed the Secretary of the Interior to take certain steps to improve the management of Federal coal reserves, and to operate a coal leasing program capable of responding to reasonable production goals. The President's National Energy Plan, which sets forth the national interest in the substitution of coal for oil and gas as an energy source, and the Power Plant and Industrial Fuel Use Act of 1978 reflect the judgement of the President and the Congress that the Federal Government should encourage and foster the use of coal. The increased demand resulting from the 1978 Act would be felt most strongly in the years between 1985 and 1990. The Department, in considering the need for leasing, must plan for the often considerable delay between the time when a mining company acquires a coal reserve and the time when production begins. Designing a mine plan, assembling equipment and constructing the mine, and studying and designing modifications required to comply with state and Federal laws takes from 4 to 7 years. In some cases, production from new leases may not begin for up to 10 years, which is the maximum delay between leasing and production allowed under the Federal Coal Leasing Amendments Act of 1976.

Because of these lags, a leasing program which results in some lease sales in 1980 could not be relied on to have a significant impact on production until after 1985. Existing leases provide an alternative to new leases as a source of coal to meet demand for 1985, because on these leases mining companies can begin now the technical and economic work required to develop production capacity. The consequences of this planning are reflected in production plans reported by those companies (see Table 2-20). Industry plans for development of existing leases and of non-Federal reserves

help account for the generally low level of new leasing assessed by the Department's studies as needed to meet 1985 production targets.

To aid in considering alternative programs to implement the President's directive that Federal coal leasing be a tool to help achieve coal production objectives, the Secretary has directed that the Department's Federal coal policy review include an analysis of the demand for Federal coal, and a review of the probable production from existing leases. As was explained, analysis of potential production and analysis of probable demand can not be done with precision because of uncertainties and variables within both the broader economy and the coal industry.

Almost all demand forecasts, however, point to significant increases in the use of coal, with both demand and production increasing at a faster rate in the western United States than in other areas. Such forecasts are reinforced by recent experience. The rate of growth in production of coal in the western states (see Table 2-7) has increased suddenly and substantially over production growth rates in the midwestern and eastern coal fields during the past few years. The rate of growth for production of coal from Federal leases, due in part to diligence requirements, is even higher than the overall western increase, making Federal reserves the most rapidly growing source of coal in the Nation.

After 1986, however, the Nation would not be able to count on significant additional production from existing Federal leases. The Department's diligent development regulations under the Federal Coal Leasing Amendments Act of 1976 require that pre-Act existing leases not in production by 1986 be cancelled, with a few possible exceptions. This means that the presently existing leases not in production by 1986 will revert to Federal ownership, and again become part of the general body of Federally owned coal reserves.

Because actions taken by the Department now will affect the potential for production of Federal coal in 1990 and beyond, the Department must consider present actions in terms of these uncertain future demands. It is clear that, to whatever degree existing Federal coal leases must be considered as an alternative to new leasing in meeting coal production needs, this alternative, already made uncertain by the environmental and economic weaknesses of earlier leasing, virtually disappears when the Department meets its responsibilities to both enforce diligent development and to recognize that today's resource management decisions would determine how much coal is available for production in 1986 and years after.

Currently planned coal production appears likely to be sufficient to meet most 1985 projected needs in the West. However, there is not much additional capacity to meet the considerably larger 1990 expected coal requirements. Unless the DOE low projections for 1990 turn out to be the correct ones, a substantial expansion in western coal production would occur between 1985 and 1990.

Because of the dominant Federal share in western coal ownership, it is natural to expect that Federal coal would play a major role in expanding western coal production between 1985 and 1990. As noted the enforcement of diligent development requirements would mean that, aside from expansions in already operating mines, increases in production of Federal coal after 1986 will have to come from

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new Federal leases. Because of the substantial time lag between the decision to hold a lease sale and actual coal production, Federal leases expected to come into production from 1986 to 1990 should be issued soon.

It is true that a resumption of significant Federal leasing in the near future runs the risk that, if low 1990 production projections are borne out, and that there would be more coal under lease than could be developed. However, the Nation's energy and coal leasing policies cannot be predicated on the assumption that future western coal production would be lower than is currently considered likely. The time lags between the decision to lease and the occurrence of actual production are such that an assumption of this nature could well be self-fulfilling.

Besides helping to meet national energy objectives, new Federal leasing is needed to ensure that future western coal development is carried out as efficiently and with as little damage to the physical and human environment as possible. Because of the large Federal ownership of western coal, a major expansion of western production without the availability of Federal coal, even if it were possible, would result in a distorted pattern of coal development, almost certainly a less efficient and environmentally satisfactory one. In many cases, the key consideration in mine site selection would become the ability to avoid the need for Federal coal, rather than the basic economic and environmental desirability of the site.

In many areas, patterns of land and mineral ownership caused by early settlement policies have created a complex division of ownership and jurisdiction, with tracts of Federal coal interspersed with private, state, and Indian coal. Because individual tracts are often not large enough to justify investments, development opportunities for non-Federal coal in many of these areas would be limited unless adjacent Federal coal could also be mined. These ownership patterns add to uncertainties about production potentials, because theoretical production of much non-Federal coal may not in fact be achievable without development of Federal coal and, conversely, a decision favoring the leasing and development of specific amounts of Federal coal may in fact lead to production of greater non-Federal reserves.

In addition to the planning and resource management requirements of the Federal Coal Leasing Amendments Act of 1976, future management decisions about Federal coal would be governed by the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. These acts, in combination, create a management and regulatory framework which provides detailed requirements for determining where, and under what circumstances, Federal coal may be leased. Taken as a whole, these laws and related regulations make the Department of the Interior's decisions about the management of Federal coal reserves conform to, and be integrated with, a broader public land planning and resource management process. The overall planning process considers all Federally managed resources, and the interests of the people and institutions that use the resources or are affected by resource use decisions.

Consideration of these other resources and interests has the effect of placing prohibitions or limitations, some mandatory and some discretionary, on the production of Federal coal. These limitations, designed to protect wildlife,

human communities, agricultural resources, private property rights, natural habitats, recreation areas, and diverse other resources and resource uses, are reasonable and flexible enough to assure that Federal coal can, in fact, be produced while the other interests are protected. Most of the protective standards and procedures were put in place within the last two years or less, long after almost all existing Federal coal leases were issued.

This means that all future leasing must not only conform to, but be a product of, a planning and regulatory process designed to be protective of the environment and of other resources and interests. Coal production decisions resulting from this process would be made in compliance with agreed-on land use planning and environmental protection requirements. However, there is no such assurance that past Federal leasing decisions made prior to the adoption of these new standards would, if the leases were produced, meet the planning and environmental requirements.

Hence, the Department, in trying to assess the potential of existing leases to serve as an alternative to unleased Federal coal in meeting future demand, must assign more uncertainty to production potential from existing leases than would be assigned to new leases. It is clear that, from an environmental standpoint, existing leases cannot be presumed to be a preferable alternative to prospective new leases. Neither, of course, can the Department assume that existing leases would fail to meet present environmental standards. To measure the possible contribution of coal from existing leases toward future energy needs, the Department must receive and review specific lease development proposals, determine if the proposed mines could be operated in conformance with present standards, and forecast the production from existing leases to compare that, and other expected production, with predicted demand for coal. A similar but, in many cases, less comprehensive analysis by state and Federal agencies would precede decisions allowing production of coal from non-Federal reserves. As in the case of already-leased Federal reserves, the Department cannot assume that the production of non-Federal coal would cause less (or more) environmental damage than would be caused by development of new Federal leases.

The decision before the Secretary at this time is whether to adopt a Federal coal management program, or an alternative, as described in this programmatic environmental impact statement, which would be capable of considering specific leasing options, as a part of the Department's responsibility for management of Federal coal resources, within a process which assures that both the need for and environmental impacts of such leasing options are adequately considered prior to a decision to hold lease sales.

Should the Secretary adopt such a program, the need for leasing would be assessed through a process which compares likely production to likely demand, determines where and when production may fall short of demand, and decides how much Federal coal should, within the limitations of resource management and environmental standards, be leased to assure production sufficient to meet demand. Evaluation of demand would include the use of the best available techniques for analysis of energy use. Evaluation of anticipated production would include all information available to the Department

about the production plans for Federal and non-Federal coal reserves.

Such a process would assure that individual proposals for specific coal leasing would be reviewed to determine their consistency with the coal production objectives of the coal management program. While such an assessment at this time shows that some new leasing should be considered now, and that the need for leasing would increase significantly in a few years if coal production forecasts for 1990 are to be achieved, the need to operate a Federal coal management program does not rest on the current assessment of future coal supply and demand. Forecasts of energy consumption and of available energy sources are based on assumptions which are subject to change. Discovery of additional or alternative energy sources, advances in technology, successes in energy conservation programs, variations in the rate of growth of electric power use, and many other factors could cause coal demand forecasts to be significantly revised, up or down. Sound long run government policy must acknowledge this uncertainty, and not assume that today's forecasts must inflexibly govern resource production decisions of the future.

The Federal coal management program described in Chapter 3 is capable of such flexibility. The process of analysis and review which incorporates sound land use planning and environmental protection with the identification of those coal reserves most suitable for development provides both industry and the Department sufficient opportunity to plan for increases in coal demand. Should demand be significantly lower than was projected, diligent development regulations would assure that leases not put into production are returned to Federal ownership. And, as the amount of Federal coal under lease increases or decreases in response to local, regional, and national demand for coal, the preferred program would assure that both site-specific and cumulative environmental impacts of Federal coal production are adequately considered.

As important as the consideration of any particular leasing options is the need for the Department to put a coal management program into operation, so decisions about the management of Federal coal can be incorporated into the land use planning systems of the Bureau of Land Management and Forest Service. Just as decisions about Federal coal can not be wisely made in isolation from decisions about wildlife management, grasslands, water, community development, and the many other resource management issues which must be considered by the Department, so those other decisions cannot be responsibly made in isolation from consideration of how Federal coal would be managed.

The preferred coal management program described in this programmatic environmental impact statement, while largely the product of intensive development during the past 18 months, has been in the preparation and review stage for five years. The operation of a complex program designed to integrate Federal coal management decisions with other Federal, state, and local resource decisions is not a simple matter. If the Nation is to be assured of meeting its future energy objectives in the most efficient and environmentally satisfactory way possible, a program for the management of the Federal coal resource is essential.

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CHAPTER 3

DESCRIPTION OF THE PREFERRED COAL MANAGEMENT PROGRAM AND ALTERNATIVES

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CHAPTER 3

DESCRIPTION OF THE PREFERRED FEDERAL COAL MANAGEMENT PROGRAM AND ALTERNATIVES

The National Environmental Policy Act of 1969 requires the preparation of an environmental impact statement on "any major Federal action significantly affecting the quality of the human environment". A principal task of the now one-year old interagency Federal coal policy review has been the selection of the proposed action for this programmatic environmental impact statement. A series of issue option papers were prepared on the alternatives and subalternatives which would affect the substance and procedures of a Federal coal management program. The selection of a set of preferred policy options from the issue option papers is the proposed action in this statement. The preferences for these policy options were expressed by the Secretary of the Interior and the Under Secretary between October, 1977 and November, 1978. The procedures followed in the coal policy review to determine the policy option preferences and the preferences themselves are outlined in section 3.3. These numerous policy option preferences have been integrated into a complete proposed Federal coal management program. This proposed program, composed of the preferred policy options, is the preferred program presented in section 3.1.1 and discussed in greater detail in section 3.2.

The policy options not preferred by the Secretary are six major alternatives to the preferred program:

- No Federal leasing until at least 1985.
- Process and lease only outstanding preference right lease applications.
- Lease only bypass coal and coal needed to maintain existing operations (emergency leasing).
- Lease to meet the coal industry's indications of need.
- Allow state determination of leasing levels.
- Lease to meet Department of Energy coal production goals.

Each alternative focuses on a different administrative and policy limitation on the determination of the level of Federal leasing to be achieved. Because of the stringent statutory and policy restrictions under which the Federal coal policy review is being conducted, any alternative to the preferred program which might be adopted would be similar in most of its details to the structure described for the preferred program. Some of the alternatives would remove certain components of the preferred program (i.e., new competitive leasing), while others merely change who makes the final decision on how much and which coal will be offered for lease sale. Various of the alternatives also differ from the preferred program in the sequence of, and extent of data required for, a coal management program. Each of the alternatives are described in sections 3.1.2 through 3.1.7. Other alternatives not analyzed in this statement and the reasons for excluding them are briefly discussed in section 3.1.8. The descriptions of the six

major alternatives are not as detailed as the description of the preferred program since, as previously noted, most of the components of the preferred program would be incorporated in the various alternatives. The more detailed description of the preferred program in section 3.2 contains an explanation of which components of the preferred program are compatible or incompatible with the other major alternatives.

Adoption of any one of these alternatives as the new Federal coal management program would likely result in regional leasing, coal production, and coal-related development activity levels different than those which would occur under the preferred program. Taken together, the preferred program and six major alternatives are intended to cover a full range of leasing, coal production and coal-related development possibilities. The estimated levels of leasing, production, and development which would result from these alternatives are presented in Chapter 5 of this statement, and are the basis of that chapter's assessment of the environmental impacts from coal development under each alternative. Chapter 5 also discusses the impact of a series of subalternatives which, if adopted, could be incorporated in one or more of the major alternatives.

To provide the reader with as complete a picture as possible of the Federal coal management program that the Secretary would select if, after review of the final version of this statement, he decides that a program is needed and if he maintains his earlier policy preferences, additional details of the preferred program are presented in section 3.2 and example regulations to show how such a program would operate are set forth in Appendix A. This detailed discussion and the example regulations should permit the reader to make more specific the comments he or she may wish to offer on this draft statement and the proposed action. All comments received by the Department on this draft statement will be considered in the preparation of the final version of this statement, the coal management program the Secretary ultimately selects, and the program's proposed regulations.

This chapter concludes in section 3.4 with a discussion of further studies now underway or planned in the coal policy review.

3.1. DESCRIPTION OF THE ALTERNATIVES

In this section, the preferred program and other alternatives are described.

3.1.1. The Preferred Program

At the outset of the Federal coal policy review, the Secretary established four primary goals the Department must

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meet for management of the Federal coal resources. These primary goals are:

- Employ land-use planning and effective enforcement of environmental laws to assure that Federal coal is produced in an environmentally acceptable manner which is responsive to local communities and land owners affected by Federal coal development.
- Assure that sufficient quantities of Federal coal are produced to help meet the objectives of the National Energy Plan.
- Assure that Federal coal is produced in an economically efficient manner, with a fair economic return to the United States for all coal produced.
- Emphasize consultation and cooperation with state governments in planning the leasing and development of Federal coal.

The preferred Federal coal management program would incorporate these goals; the expressions of preference for certain policy options by the Secretary and Under Secretary; the requirements of the appropriate statutes, principally the Mineral Leasing Act of 1920, the Federal Coal Leasing Amendments Act of 1976, the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977; and the direction provided by the President in his 1977 Energy and Environmental Messages to the Congress.

The preferred program includes eight major elements:

- A planning system, involving close consultation with state and local governments, industry, and the public, (1) to decide which areas of Federal coal reserves would be considered acceptable locations for coal production, and (2) to delineate, rank, and select for sale specific tracts of coal.
- A system for evaluating, in conjunction with the Department of Energy, the national demand for coal and for determining production which should be stimulated by the leasing of Federal coal.
- Procedures for conducting sales and issuing leases.
- Post-lease enforcement of terms and conditions.
- Procedures for management of existing leases issued prior to implementation of the new program.
- Procedures for processing existing preference right lease applications.
- A strategy to integrate the environmental analysis requirements of the National Environmental Policy Act of 1969 in the new program.
- Procedures to start-up the new program and to offer lease sales in emergency situations.

Set forth below is a general overview of the eight major elements of the preferred alternative for a Federal coal management program. Figure 3-1 displays a simple flow chart for the preferred alternative.

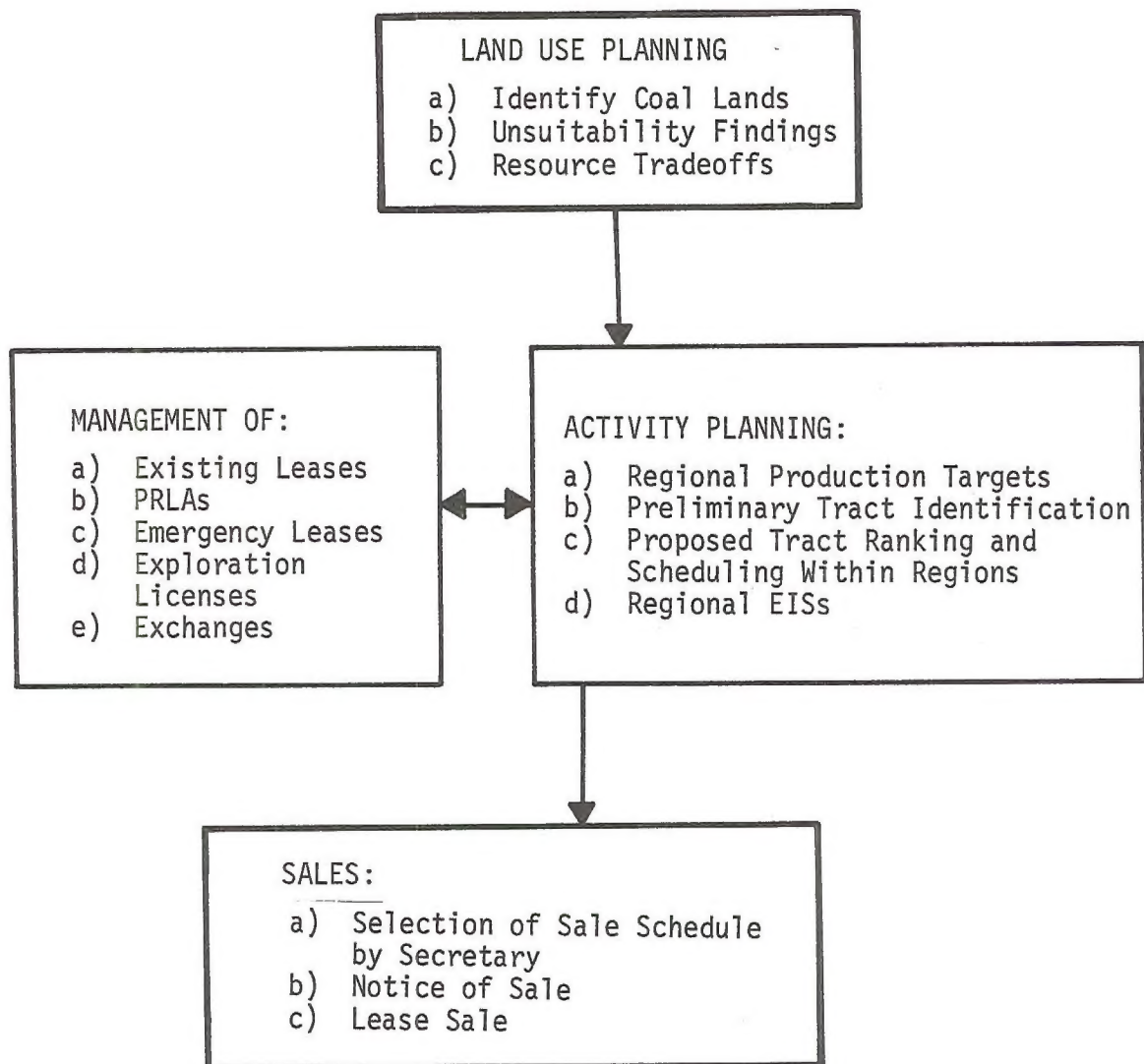
This draft environmental impact statement includes in Appendix A a set of example regulations for the preferred program. The example regulations are meant to indicate to the reader what type of regulations the Department might propose if the Secretary were to select the preferred program. Example regulations are provided in order to respond to one of the principal public and judicial criticisms of the final environmental impact statement for the last proposed Federal coal management program: i.e. that the preferred program

was not adequately described (see Chapter 1 for a discussion of EMARS and the decision in *NRDC v. Hughes*). The text which follows presents a lengthy overview of the preferred program and a more detailed discussion of certain aspects of the program (Section 3.2). These example regulations, however, should provide the reader with a more complete picture of how the program would be administered.

Although Appendix A contains example regulations only, the Department, simultaneous with the issuance of this draft environmental impact statement, will give notice in the *Federal Register* of intent to propose rules together with a full description of the regulation development process. During March 1979, the Department will publish the proposed rulemaking. Comments on program elements described in this statement will be considered in the drafting of this proposed rulemaking. By scheduling the proposed rulemaking to fall between the publication dates for the draft and final environmental impact statements, the Department seeks to provide the public with sufficient time to comment on the proposed rules without the burden of being asked to simultaneously address the varied issues discussed in an environmental impact statement. Inclusion of example regulations and the detailed program description in this statement offers interested citizens additional time to become familiar with the preferred program and to develop their views of it prior to being requested to make specific comments on the proposed regulations. If the Secretary decides to adopt a coal management program in June 1979, the final regulations will be prepared and published within two months following the date of his decision. The preparation period following the Secretary's decision will be as short as possible, but of sufficient length to provide the Department with the time necessary both to ensure that the final regulations fully and accurately reflect the Secretary's decision and to take into consideration the general comments received during the environmental impact statement process and the specific comments submitted on the proposed regulations.

For a similarly detailed understanding of all the Department's coal-related activities, the reader may wish to review the regulations of the United States Geological Survey under 30 CFR Part 211 published in 43 Federal Register 37181-37196 on August 22, 1978; the proposed regulations of the Office of Surface Mining Reclamation and Enforcement under 30 CFR Chapter VII published in 43 Federal Register 41552 - 41940 on September 18, 1978; and proposed planning regulations for the Bureau of Land Management scheduled to be published in the Federal Register shortly before or simultaneously with the publication of this statement. Finally, the reader may also wish to consult the Forest Service's proposed planning regulations under 36 CFR 219 published in 43 Federal Register 39046-39059 on August 31, 1978. The Geological Survey is expected to publish proposed permanent regulations by the end of the year.

3.1.1.1 Planning Systems. In the preferred program, the Department would rely on the land management agencies' planning systems, in both the land use and activity planning stages, to provide the initiative and the forums for the making of the principal decisions in the Federal coal management program.



(See Figures 3-2, 3-3, and 3-4 for more detailed presentations of the preferred program.)

FIGURE 3-1

SUMMARY OF THE PREFERRED PROGRAM

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Land Use Planning. The critical decision during the land use planning process, under the preferred program, would be the delineation of areas acceptable for further consideration for coal leasing. The areas acceptable would be identified by screening out areas that:

- Are considered not to contain coal reserves of high to moderate development potential.
- Are considered unsuitable for leasing under the provisions of Section 522 of the Surface Mining Control and Reclamation Act (SMCRA) and the President's Environmental Message through the application of lands unsuitability criteria.
- Are considered to be of higher value for other uses as determined by multiple-use, resource management trade-off decisions. In addition, areas that split estate lands where the coal would be recovered by surface mining methods and the surface owners (as defined in SMCRA) have indicated a definite preference against surface mining of their land may also be screened out.

The land use plan could also limit development levels or rates within the areas identified as acceptable for further consideration for coal leasing. As an example, a threshold for mining employment might be established in response to state government requests for planning to affect community growth rates, or a threshold on the population of a particular wildlife species might be established for resource conservation reasons in those areas. Then, the Federal land manager would not lease coal if the additional development could be expected to push total mine employment in the area over, or the total population of the particular species under, the threshold levels. Thresholds would be used to control impacts which depend on an overall development level rather than on site-specific effects.

Activity Planning. Activity planning for each Federal resource in the planning area follows completion of the land use plan. Under the preferred program, coal resource activity planning would involve the delineation, ranking, and selection of tracts for lease sale from the land identified in the land use plan as areas acceptable for further consideration for leasing.

The first step in activity planning would be to delineate preliminary tracts from within the acceptable areas. The boundaries of the preliminary tracts would be based primarily on considerations of technical coal data, resource conservation considerations, and surface ownership patterns. Readjustments of boundaries to reflect environmental or social considerations would occur as the tract ranking and selection process proceeds.

Although preliminary tract delineation would be done by the land management agencies, first industry would be requested to submit expressions of interest in possible tracts and the states would be encouraged to suggest possible tracts, particularly tracts of importance to the leasing of state-owned coal. These submittals would be requested immediately after acceptance of the land use plan. They would be a critical element in the decisions on delineation and subsequent ranking of tracts since the areas of industry and state interest would normally reflect important data collected by the states and industry.

Once the land management agency has identified preliminary tracts, it would begin analyzing the potential

environmental impacts related to each tract. The agency would work closely with other Federal agencies, State and local governments, and other interested parties during this process.

As the next section discloses, the Department has divided the country into coal production regions to develop regional production targets. In cooperation with all involved land management agencies and the affected state and local governments, the Department would rank all available tracts within a production region. Generally, ranking would take place every four years. Selected from these ranked tracts would be those tracts to be included in a proposed lease sale schedule. The number of tracts selected and the proposed timing of their sale would be determined by considering the production target for the region established by the Department, the share of the target which could be met from non-Federal coal and from existing, and prospective emergency and non-competitive, Federal leases, and the analysis of the impacts related to the production target. Should the Federal leasing target appear to exceed greatly the producible coal in the more highly ranked Federal tracts, the regional production target itself could be reevaluated and modified. The tract delineation, ranking, and selection decision would be discussed in an environmental impact statement which would consider the site specific impacts and cumulative regional impacts which would ultimately result from the sale of leases for the selected tracts.

The participation of state and local governments would be sought actively during the tract ranking and selection process, particularly to ensure consideration of social and economic impacts and problems associated with potential coal development. The public would also participate in this process. Hearings would be held in or near all regions if the Secretary determines they are needed. Regardless of the public participation process employed, public hearings would be held on the environmental impact statement prepared on the regional tract delineation, ranking, and selection process.

From among the tracts selected for lease sale, the Secretary would designate, where appropriate, specific tracts to be offered for sale only to small businesses and to public bodies (Federal and state agencies, municipalities, and rural electric cooperatives and similar organizations, and nonprofit corporations controlled by any of those entities). The decision on these two types of set-aside sales would be made after the Secretary reviews the information provided by public bodies through submissions of expressions of interest in the activity planning process and consults with the Small Business Administration.

Stipulations would be attached to the proposed leases for the tracts selected for lease sale to mitigate adverse environmental and social impacts. These stipulations would incorporate measures which the Department considers necessary as a result of the environmental analyses of the land use planning and activity planning processes. The leases would also require compliance with the Surface Mining Control and Reclamation Act of 1977.

Before making a final decision on which, if any, tracts to offer for lease sale, the Secretary would formally consult with the governors of states in which tracts are being proposed for sale. Should a governor object to the offering of any proposed tract within his state, he would be given a period of time in

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which to prepare and present his arguments to the Secretary. The Secretary could also schedule additional public hearings in the local area if should he determine they are needed.

3.1.1.2 Production Targets. The major coal bearing areas of the country have been divided into 12 coal production regions. Eight of these regions contain significant reserves of Federal coal. These regions play a key role in the preferred alternative for a Federal coal management program. Each region will be managed largely as a separate coal production unit. Biennially the Department of Energy (DOE) updates its national coal production targets in accordance with its responsibilities under the Department of Energy Organization Act. These targets would be submitted to the Department of the Interior. The Department would review and, if necessary, adjust the portion of the national targets which applies to the eight regions containing Federal coal. Within each of these eight regions, a total regional production target and, based on an assessment of new leasing needs, a production target for new logical mining units containing Federal coal leases would be formulated. These targets would become preliminary production targets for each region. Selection of targets includes consideration of the full range of Federal land management responsibilities and applicable statutory requirements and policies of the State. In considering new DOE targets, the Department of the Interior would review the analyses in this programmatic environmental impact statement (updated when necessary) and subsequent post-programmatic regional lease sale environmental impact statements. It would also assess the success of the previous delineation, ranking, and selection of tracts in each region; industry surveys; and information developed by other institutions and organizations. Final regional production targets would be established by the Secretary only after he has first consulted with the states, and then has offered the public and industry the opportunity to submit comments on the preliminary targets.

Although the final regional production targets would not be used directly in making Federal coal leasing decisions until the tract selection process, these regional targets would enable both the Federal and state governments to set data gathering and planning priorities. These priorities would be established to ensure that a sufficient number of tracts are delineated and enough site-specific information is generated to make the regional tract ranking and selection process workable.

The analysis completed on the tracts available but not selected in the previous ranking and selection process for the regions would assist the Department in projecting cumulative impacts of future lease sales. These impacts could then be considered when the Department again considers regional targets. Using this process, the setting of regional production targets would supply guidance to the tract ranking and selection process which, in turn, would supply guidance for the next update of the targets.

3.1.1.3 Lease Sales. Each tract selected by the Secretary for lease sale would be analyzed to determine the appropriate fair market value and its maximum economic recovery requirements. Comments on the fair market value and maximum economic recovery would be taken before the sale.

The method for conducting the sales could vary from sale to sale. One of the main sale differences would be between

single tract and intertract sales. In intertract sales more tracts are offered for sale than would be awarded. The intertract sale is designed to encourage competition over all the tracts when competition for each tract individually may be lacking. This form of sale would be employed for certain sales involving split estate lands. The responsibility for promulgating regulations concerning the bidding systems to be employed in lease sales belongs to the Department of Energy. In no case would bids for less than fair market value be accepted.

Particular tracts may have been set aside in tract activity planning for public body or small business special lease sale opportunities. These tracts would be sold in separate sales with only qualified public body and small business firms permitted to bid. In these set-aside lease sales, no bids for less than fair market value would be accepted and no special variation in calculating fair market value would be used. Set aside tracts on which no successful bids are received would be released for the subsequent general sale, if one is scheduled.

The Attorney General would review all successful high bidders for antitrust implications before the leases could be issued. Each lease issued would contain provisions in accordance with regulations promulgated by the Department of Energy to ensure diligent development of the coal and continued operation of the mine.

3.1.1.4 Post-Lease Enforcement of Terms and Conditions. After a lease has been issued, the Office of Surface Mining Reclamation and Enforcement, or, if a cooperative agreement has been signed with the state, the appropriate state agency, would enforce the environmental stipulations set forth in the lease and in the mining permit. The mining permit would have to be obtained by the lessee from the state agency or the Department of the Interior before mining operations begin. To obtain the permit, the lessee would be required to submit a mining plan for approval by the state agency or the Department. The lessee would have to file bonds both to ensure that certain financial commitments to the Federal Government are met and to cover the cost of reclamation by the Federal land management agency should the lessee fail to meet all his reclamation requirements. The general post-lease program is discussed in the Draft Environmental Statement for the Permanent Regulatory Program under SMCRA [5].

3.1.1.5 Management of Existing Leases. The Department would apply the same land use planning and unsuitability standards to existing nonproducing leases as are applied to new leases. Such application would respect valid existing rights and substantial financial and legal commitments and other exemptions in SMCRA and other laws. The lessee would submit a mining plan before the Department would conduct a comprehensive review of the lease.

Under this approach, the leases of lessees who do not attempt to achieve production would lapse for failure to meet diligence requirements. When a mining plan is submitted, the Department would review both whether the plan is consistent with the reclamation standards of SMCRA and whether coal development is consistent with current planning and acceptability requirements.

Should the review indicate no major problems, the Department would process the mining plan under normal procedures. If major problems exist, however, it would seek to

would and
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for each lease sale?
answered
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work them out with the lessee or reject the mining plan for failure to comply with SMCRA.

Finally, as part of the process of determining the need for new leasing, and in setting the regional production targets, the Department has evaluated, and would continue to evaluate, the production potential from existing leases.

3.1.1.6. Processing of Preference Right Lease Applications. As with existing leases, the Department would adopt a policy of applying to preference right lease applications the same environmental and planning standards as those applied to new leases. The Department would integrate the current standards into the process for determining lease entitlement through the showing of commercial quantities of coal.

Needed environmental stipulations would be derived after the applicant submits the initial commercial quantities showing. If the final commercial quantities showing is then successfully made, the Department would issue the lease. If not, the application would be rejected. The Department would prepare environmental assessments on these leases in the same manner as it does on new competitive leases.

3.1.1.7. Meeting the Requirements of the National Environmental Policy Act. A regional environmental impact statement would be prepared on a four year schedule of lease sales in each region identified in this programmatic environmental impact statement. Each regional sale statement would include analysis of both the site-specific and intraregional cumulative impacts of the proposed leasing actions. The regional production target, the tract delineation and ranking process, the proposed selection of tracts to be leased, and the lease sale schedule would be reconsidered two years later when the next biennial process of establishing new regional production targets is completed. If, in any region, substantial differences are found in tract ranking (because of the preparation of additional land use plans or changed environmental, social, or economic conditions) or if there is a new regional production target requiring a major change in the tracts proposed for sale, a supplement to the regional sale statement would be prepared. At the time of the second consecutive biennial consideration of regional production targets and ranking of tracts, new four-year regional environmental impact statements would be prepared.

National and interregional impacts of the Federal coal management program would be analyzed in this programmatic environmental impact statement. The document would be updated when conditions change sufficiently to require new analyses of those impacts.

It is expected that additional environmental impact statements would also be prepared on the individual land use plans of the land management agencies. As each land use plan addresses all public land resources and uses, not just coal and coal development, this environmental impact statement decision would be broadly based. It would include an environmental impact analysis of any decision in the plan to identify lands as acceptable for further consideration for coal leasing, including the application of the unsuitability criteria and the resource trade-offs which led to the decision.

Presently, the Department is preparing environmental impact statements on eight regions with high coal development potential. These regional statements discuss

mining plans for existing leases and related developments. They do not address any renewed competitive leasing such as might result from the adoption of a new Federal coal management program. Where, however, the analyses in these regional statements would be applicable to analyses needed in the new regional sale statements proposed in the preferred program, they would be incorporated in the new regional sale statements.

3.1.1.8. Emergency Leasing and Start-up of the Program. To keep the costs of the coal management program within bounds, should any leasing be contemplated in the near future the entire program would be phased in gradually during the first few sales. The greatest differences between a mature program and start-up procedures would be that, first, the unsuitability criteria would be applied directly to lands which have already been found acceptable for further consideration for coal leasing in existing land use plans and, second, the regional sale environmental impact statement would not necessarily include a full four-year sales schedule.

Once the program is in full operation, situations might arise in which the full planning-through-sale cycle of decision making could not respond quickly enough to avoid causing unfair losses for the coal operations and economies of certain locations. To meet these situations, an emergency leasing system would be a component of the program. The emergency system would use existing land use plans or land use analyses where appropriate and shorten greatly the activity planning stage. No tract, however, would be offered under this system that had not been the subject of an environmental assessment, including the application of unsuitability criteria. Emergency lease applications would be considered only in cases where Federal coal would be by-passed, where coal is needed to continue existing production or meet existing contract requirements, or where coal would be mined in connection with gaining access to other coal deposits. It is expected that the need for emergency leasing would diminish over time. Only enough reserves would be leased to sustain the applicant until a permanent decision could be made under the full planning-through-sale cycle of the coal management program. Emergency leasing would not be permitted to substitute for the procedures required in the full decisionmaking cycle. Emergency applications which are not compatible with existing land use plans for the area would be rejected.

3.1.2 No Federal Leasing

Under this alternative, no new Federal coal would be leased until at least 1985. All preference right lease applications would be rejected, not processed during this period, exchanged for other mineral leases, or purchased. There would be no leasing for bypass situations or to maintain existing operations. The supply of Federal coal available for development would consist of that coal already under lease, including coal which may have been previously leased under the consent agreement in *NRDC v. Hughes*.

Selection of this alternative implies that the government has decided that leasing is not needed within the planning horizon to 1985. The production under this alternative could reach the same levels as the preferred program or the alternative of leasing to meet DOE production goals since

these programs could have outcomes of no leasing in one or more of the study regions.

Compared to the preferred program and other alternatives, the no leasing alternative would likely stimulate the largest number of proposals for development of existing leases for which currently no mining plans have been submitted. In each of these cases, and after the mining plan is filed, the leasehold would be examined in light of the lands unsuitability criteria presented in Table 3-1. This examination would be carried out through the land use planning system in a fashion similar to that previously described for determining areas acceptable for further consideration for coal leasing. Those leases which are found unsuitable would be revoked using the appropriate, available legal tools: exchange, purchase, etc. This alternative would also stimulate the largest number of proposals for development of non-Federal coal.

3.1.3 Process Outstanding Preference Right Lease Applications

Under this alternative, the Federal government would process preference right lease applications (PRLAs) and issue leases for those applications which meet the commercial quantities test. However, no other Federal leasing would occur at least until 1985. The processing of PRLAs would occur as rapidly as would be administratively feasible. If it were necessary to set priorities in the processing of PRLAs, the following general guidelines would be applied:

- First, PRLAs in the least environmentally damaging areas.
- Second, PRLAs in areas where coal development needs are greatest.
- Third, PRLAs which have been on file for the longest period.

Choice of this alternative would require that those PRLAs in areas which are determined environmentally unacceptable, but which still meet the commercial quantities test (with proper environmental stipulations applied), would either have to be purchased or otherwise acquired (e.g. through lease exchanges). As with the no leasing alternative, this alternative is not necessarily inconsistent with the preferred program or with the alternative of leasing to meet DOE production goals; leasing level targets under those alternatives could be met with coal from PRLAs.

Existing leases would be managed as described under the no leasing alternative.

The surface owner consent provisions of SMCRA do not apply to PRLAs. Environmental analysis to comply with NEPA could be done on a case-by-case basis.

3.1.4 Emergency Leasing

This alternative would provide for limited competitive leasing. Emergency leases would include the relatively small amounts of Federal coal which could be leased to avoid bypassing Federal coal or to maintain existing operations. Bypass situations will occur in small Federal ownership blocks within presently operational mine areas which, if not leased, are not likely to be mined at all. Leasing of PRLAs would be permitted only if they meet either the "bypass" or "existing operations" criteria. These limited leasing criteria would be similar to current criteria for short-term leasing under the

NRDC v. Hughes consent agreement. As with the two previous alternatives, this alternative precludes other new competitive Federal coal leasing, at least until 1985, with a review of the need for new leasing anticipated at that time. Existing leases could be managed as described under the no leasing alternative.

The maximum amount of bypass coal eligible for lease under this alternative would be that agreed to under the *NRDC v. Hughes* consent agreement (i.e., 5 years of production at existing rates). Similarly, the maximum amount of coal that would be leased to maintain an existing operation would be defined by the *NRDC v. Hughes* agreement (8 years of production at existing rates).

In specifying this alternative, the eligibility of existing operations to lease additional Federal coal to maintain their production would have to be restricted. Under this alternative, it was decided that the mining operation must have been in existence at least 5 years and must not have previously obtained a new Federal lease in order to maintain the existing operations. This decision, however, will have to be reviewed if the Secretary elects this alternative. It should be noted that this restriction in some respects is tighter than the comparable short-term leasing standards under the *NRDC v. Hughes* agreement, wherein mines must only have been operating by September 1977 to be eligible to lease Federal coal on short-term basis. Application of surface owner consent would be required and, where appropriate, lands unsuitability criteria and general planning analysis would be required.

3.1.5 Lease to Satisfy Industry's Indications of Need

This alternative is effectively the Energy Minerals Activity Recommendation System (EMARS II), as proposed by the Department in the September 19, 1975, final environmental impact statement on the Federal coal leasing program. Additions are made to bring the program into compliance with the Federal Land Policy and Management Act of 1976, the Federal Coal Leasing Amendments Act of 1976, and the Surface Mining Control and Reclamation Act of 1977.

Under this alternative, industry would first be asked to indicate those tracts it is interested in leasing. At the same time, the public would be asked to indicate those areas where leasing would be restricted. Coal demand estimates would serve as a development restriction and would enter the planning process through the Planning Area Analysis step in the land-use planning process. Such information would then be processed through the land management agencies' planning systems to determine whether the specific tracts were environmentally acceptable and whether coal development represented an efficient use of the land. Tracts which are judged acceptable would then be offered in a future sale. Each tract receiving a high bid equal to or above fair market value as determined by the Department would be leased to the high bidder. Major difference, between this alternative and the preferred alternative are that regional environmental and socio-economic concerns would not weigh in the location of sites and that more leasing than needed by the market could take place because of speculative interest in leases.

TABLE 3-1

RECOMMENDED UNSUITABILITY CRITERIA

	CRITERION	EXCEPTIONS
<u>Federal Land Systems</u>	<p>All Federal lands included in the following land systems or categories and an appropriate buffer zone, if necessary, as determined by the land management agency, shall be considered unsuitable for coal mining: National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, and other Federally purchased recreation lands, Custer National Forest, and Federal lands in incorporated cities, towns, and villages. All Federal lands which are recommended for inclusion in such systems or categories by the Administration in legislative proposals submitted to the Congress or which are required by statute to be studied for inclusion in such systems or categories shall be considered unsuitable for coal mining.</p>	<p>A lease may be issued for underground coal mining within the Custer National Forest with the consent of the Department of Agriculture.</p>
<u>Rights-of-Way and Easements</u>	<p>Federal lands that are within rights-of-way and easements and within surface leases for residential, commercial industrial, public purposes, and agricultural crop production on Federally-owned surface shall be considered unsuitable for coal mining.</p>	<p>A lease may include such areas if the land management agency determines that:</p> <ol style="list-style-type: none"> (1) Coal development (e.g., underground mining) will not interfere with the purpose of the right-of-way or easement, or (2) The right-of-way or easement was granted for mining purposes, or (3) The right-of-way or easement was issued for a purpose for which it is not being used, or (4) The parties involved in the right-of-way or easement agree to leasing, or (5) It is impractical to exclude such areas due to the location of coal and method of mining and such areas can be protected through use of appropriate stipulations.
<u>Buffer Zones Along Rights-of-Way and Adjacent to Communities and Buildings</u>	<p>Federal lands affected by Section 522(e) of the Surface Mining Control and Reclamation Act shall be considered unsuitable for coal mining. This includes land within 100' outside of the right-of-way of a public highway or within 100' of a cemetery, and within 300' of an occupied building, school, church, community or institutional building or public park or within 300' of an occupied dwelling.</p>	<p>A lease may include mine access roads or haulage roads that join the right-of-way for a public road. Additionally, the Surface Mining Regulatory Authority may issue a permit to have public roads relocated. Finally, owners of occupied buildings may give permission to mine near the buildings.</p>

TABLE 3-1 (CONTINUED)

	<u>Criterion</u>	<u>EXCEPTIONS</u>
<u>Wilderness Study Areas</u>	Federal lands designated as wilderness study areas shall be considered unsuitable for coal mining while under review by the Administration and the Congress for possible wilderness designation. For any Federal land which is to be leased or mined prior to completion of the wilderness inventory by the land management agency, the environmental impact statement (or analysis) of the lease sale or mine plan must consider whether the land possesses the characteristics of a wilderness study area. If the finding is affirmative, the land shall be considered unsuitable for coal mining.	Issuance of noncompetitive coal leases and mining on leases may proceed if authorized by the Wilderness Act and the Federal Land Policy and Management Act of 1976.
<u>Scenic Areas</u>	Scenic Federal lands designated by visual resource management analysis as Class I or II (areas of outstanding scenic quality and/or high visual sensitivity) but not currently on the National Register of Natural Landmarks shall be considered unsuitable for coal mining.	A lease may be issued if the land management agency determines that coal mining will not significantly diminish or adversely affect the scenic quality of the designated area.
<u>Lands Used for Scientific Studies</u>	Federal lands under permit by the land management agency, and being used, for scientific studies involving food and fiber production, natural resources or technology demonstrations and experiments shall be considered unsuitable for coal mining.	A lease may be issued: <ol style="list-style-type: none"> 1. With the concurrence of the principal scientific user or agency, or 2. Where the mining could be done in such a way as not to jeopardize the purpose of the study as determined by the land management agency.
<u>Historic Lands and Sites</u>	All districts, sites, buildings, structures, and objects of historic, architectural, archeological, or cultural significance which are included in or eligible for inclusion in the National Register of Historic Places, and an appropriate buffer zone around the outside boundary of the property (to protect the inherent values of the property that made it eligible for listing in the National Register) as determined by the land management agency, in consultation with the Advisory Council on Historic Preservation or by procedures approved by the Advisory Council, shall be considered unsuitable for coal mining.	Leasing may be allowed if the land management agency determines: <ol style="list-style-type: none"> 1. The site, structure, or object is of regional or local significance only with the concurrence of the State, or 2. In consultation with the Advisory Council on Historic Preservation, the direct and indirect effects of coal mining to properties on or eligible for the National Register of Historic Places will not result in significant adverse impacts to the site, structure, or object.

TABLE 3-1 (CONTINUED)

	CRITERION	EXCEPTIONS
	included in the determination of buffer zones.	determines the active falcon nests will not be adversely affected.
<u>Migratory Birds</u>	Federal lands which are high priority habitat for migratory bird species of high Federal interest on a regional or national basis, as determined jointly by the Federal land management agency and the Fish and Wildlife Service, shall be considered unsuitable for coal mining.	A lease may be issued where the land management agency, after consultation with the Fish and Wildlife Service, determines that coal mining will not adversely impact the migratory bird habitat during periods when such habitat is used by the species.
<u>State Resident Fish and Wildlife</u>	<p>Federal lands which the land management agency and the State jointly agree are fish and wildlife habitat for resident species of high interest to the State and which are essential for maintaining these priority wildlife species shall be considered unsuitable for coal mining.</p> <p>Such lands shall include:</p> <ul style="list-style-type: none"> - Active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken. - The most critical winter ranges for deer, antelope and elk. - Migration corridors for elk. <p>Such lands may include appropriate buffer zones as determined jointly by the land management agency and the State.</p>	<p>A lease may be issued if:</p> <ol style="list-style-type: none"> 1. It is demonstrated that complete mitigation is possible; or 2. Following discussions between the State wildlife agency and the Federal land management agency, the Federal land management agency determines that the species being protected will not be adversely affected by the mining activity.
<u>Wetlands</u>	Federal lands containing: (1) inland lakes, impoundments, and associated wetlands; (2) inland shallow, predominantly vegetated wetlands; or (3) riverine wetland systems, lower perennial and upper perennial systems with flow greater than 5 cubic feet per second and riparian zones in a "relatively undisturbed" state that are larger than one linear mile along a riverine system, shall be considered unsuitable for coal mining.	<p>A lease may be issued where the land management agency determines that:</p> <ol style="list-style-type: none"> 1. The use of appropriate mining or reclamation technology will not significantly affect the wetlands or will provide for complete restoration, or 2. The wetlands contain no significant values for groundwater recharge, fish and wildlife habitat, recreation or scientific study.
<u>Floodplains</u>	Riverine, coastal, and special floodplains (100-year recurrence interval) shall be considered unsuitable for coal mining.	<p>Leasing may be allowed where the land management agency determines that:</p> <ol style="list-style-type: none"> 1. Leasing a particular tract is the only practicable alternative; and 2. Potential for harm to people or property and natural and beneficial values of floodplains can be minimized through use of demonstrated and available mining and mitigation measures.
<u>Municipal Watersheds</u>	Federal lands which have been committed by the land management agency to use as municipal watersheds shall be considered unsuitable for coal mining.	<p>Leasing may be allowed where:</p> <ol style="list-style-type: none"> 1. The land management agency determines that mining will not adversely affect the watershed to any significant degree, and 2. The municipality or water users concur in the issuance of the lease.

TABLE 3-1 (CONTINUED)

	CRITERION	EXCEPTIONS
<u>National Resource Waters</u>	Federal lands with National Resource Waters, as identified by States in their water quality management plans, and a buffer zone of Federal lands $\frac{1}{4}$ mile from the outer edge of the far banks of the water, shall be considered unsuitable for coal mining.	The buffer zone may be eliminated or reduced in size where the land management agency determines that it is not necessary to protect the National Resource Waters.
<u>State Lands Unsuitable</u>	A buffer zone of Federal lands necessary to provide protection for any adjacent area designated as land unsuitable for mining by the State shall be considered unsuitable for coal mining.	The buffer zone may be modified or eliminated where the land management agency, in consultation with the State, determines that all or parts of the zone are not necessary to protect the designated area.
<u>State Proposed Criteria</u>	Federal lands in a State to which is applicable a criterion (i) proposed by the State, and (ii) adopted by rulemaking by the Secretary of the Interior, shall be considered unsuitable for coal mining.	A lease may be issued for any area: <ol style="list-style-type: none"> 1. Irrespective of the applicability of the State-nominated criterion, if such criterion is adopted by the Secretary less than 12 months prior to the publication of the draft land use plan which applies to such area; or 2. Where the land management agency in consultation with the State determines that, although the criterion applies, mining will not adversely affect the value which the criterion would protect.
<u>Prime Farm Lands</u>	When the land management agency, with the concurrence of the Secretary of Agriculture (Soil Conservation Service), identifies Federal lands having prime farm land soils, such lands shall be considered unsuitable for coal mining.	A lease may be issued when: <ol style="list-style-type: none"> 1. Conditions such as soil rockiness, angle of slope or historic or other conditions leading to a negative determination under permanent regulations of the Office of Surface Mining Reclamation and Enforcement (OSM) are present; or 2. Scientific studies show that crop yields equivalent to pre-mining crop yields on non-mined prime farm lands in the surrounding area under equivalent levels of management could be obtained and that an operator or potential operator could meet the soil reconstruction standards in section 515(b)(7) of the Surface Mining Control and Reclamation Act (SMCRA) and OSM's permanent regulations.

TABLE 3-1 (CONTINUED)

<u>Natural Areas</u>	<u>CRITERION</u>	<u>EXCEPTIONS</u>
	Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable for coal mining.	Leasing may be allowed in these areas or sites if the land management agency determines that: <ol style="list-style-type: none"> 1. The area or site is only of regional or local significance only with the concurrence of the State, or 2. The use of appropriate mining technology will result in no significant adverse impact to the area or site, or 3. The mining of the coal resource will enhance information recovery (e.g., paleontological sites).
<u>Federally Listed Endangered Species</u>	Legally designated critical habitat for Federal threatened/endangered (T/E) plant and animal species, and habitat for Federal T/E species which is determined by the Fish and Wildlife Service and the land management agency to be of essential value and where the presence of T/E species has been scientifically documented, shall be considered unsuitable for coal mining.	Leasing may be allowed if, after consultation with the Fish and Wildlife Service, the land management agency determines the species habitat will not be adversely affected by coal development.
<u>State Listed Endangered Species</u>	Habitats deemed critical or essential for plants and animal species listed by the State pursuant to State law as endangered or threatened shall be considered unsuitable for coal mining.	A lease may be issued if, after consultation with the State, the land management agency determines that the species will not be adversely affected by the coal development.
<u>Bald and Golden Eagle Nests</u>	Bald and golden eagle nests that are determined to be active and a buffer zone of land in a $\frac{1}{4}$ mile radius from the nests are areas which shall be considered unsuitable for coal mining, except that, during the non-breeding season, mining can be conducted within the buffer zone. Consideration of availability of habitat for prey species shall be included in the determination of buffer zones.	A lease may be issued if: <ol style="list-style-type: none"> 1. It can be conditioned in such a way, and during periods of time, that eagles will not be disturbed during breeding season, or 2. A permit or special approval is granted by the Fish and Wildlife Service to allow the eagle nest to be moved. Buffer zones may be increased or decreased if the land management agency determines that the active eagle nests will not be adversely affected.
<u>Bald and Golden Eagle Roost and Concentration Areas</u>	Bald and Golden Eagle roost and concentration areas used during migration and wintering shall be considered unsuitable for coal mining.	A lease may be issued if the land management agency determines that mining can be conducted in such a way, and during such periods of time, to ensure that eagles will not be adversely disturbed.
<u>Falcon Cliff Nesting Sites</u>	Federal lands containing falcon cliff nesting sites with active nests and a buffer zone of Federal lands $\frac{1}{4}$ mile radius from the nest to provide needed prey shall be considered unsuitable for coal mining, except that, during the non-breeding season, mining can be conducted within the buffer zone. Consideration of availability of habitat for prey species shall be	A lease may be issued if: <ol style="list-style-type: none"> 1. The land management agency determines that coal mining will not adversely impact the nesting sites during the breeding season, or 2. Nest sites may be moved with concurrence of the Fish and Wildlife Service. Buffer zones may be increased or decreased if the land management agency

TABLE 3-1 (CONCLUDED)

	<u>CRITERION</u>	<u>EXCEPTIONS</u>
<u>Alluvial Valley Floors</u>	Federal lands identified by the land management agency, with the concurrence of the State in which they are located, as alluvial valley floors according to the definition and standards of the SMCRA, regulations, final alluvial valley floor guidelines, and approved State programs, where mining would interrupt, discontinue, or preclude farming shall be considered unsuitable for coal mining. Additionally, when mining Federal land outside an alluvial valley floor would materially damage the quantity or quality of water in surface or underground water systems which would supply alluvial valley floors, that land shall be considered unsuitable for coal mining.	A lease may be issued where mining would not interrupt, discontinue, or preclude farming on land to which the first sentence of the criterion applies.
<u>Reclaimability</u>	As information regarding reclaimability on a local or regional basis becomes available, the land management agency shall use such information to determine if areas of Federal land are reclaimable to the standards of SMCRA, the regulations, and approved State programs. Examples of information on reclaimability would be soil studies, hydrologic studies, and studies concerning revegetation. If any area is determined not to be so reclaimable, such area shall be considered unsuitable for coal mining.	A lease may be issued upon presentation of information which contains results of studies showing that reclamation is possible to the standards of the SMCRA, OSM's permanent regulations and approved State programs, including State regulation.

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Existing leases and PRLAs would be managed as described earlier. This alternative would also include procedures for emergency leasing of small tracts as described earlier. NEPA compliance could proceed as under the preferred program. The surface owner protection provisions of section 714 of SMCR would apply.

3.1.6 State Determination of Leasing Levels

Under this alternative, the states would have the responsibility to determine the timing and extent of new Federal leasing. There are many procedural structures that could be used to implement this alternative. The states, rather than the Secretary with state consultation, could select and rank tracts from areas acceptable for further consideration for coal leasing as determined through the Federal land management agencies' land use planning systems. States would determine a lease sale schedule; thereafter, the appropriate BLM State office would conduct the sale. The states would have veto power over which leases would finally be issued.

A second possible structure would be to transfer all land use planning and environmental analysis functions to the appropriate State planning office. The Department would retain only the responsibility to conduct lease sales and to issue leases. Both structures would require Congressional action to amend the governing statutes, especially FLPMA and SMCR.

Existing leases and PRLAs would be managed as described before, but the states could have a final veto on the acceptability of any area for coal mining and could have responsibility for approval of mining plans for Federal mines. Furthermore, it is assumed that this alternative would include an emergency leasing provision as described in section 3.3.3. States would be delegated the responsibility to obtain appropriate surface owner consents.

The Department chose this alternative and its variations for analytical purposes only. The alternative and its variations have not been requested by the states themselves although they were consulted to assess the comparative impacts of this alternative. It was necessary to solicit state statements of present preferences for leasing levels. The Department requested each western state with substantial reserves of unleased Federal coal to specify what production level it would like to see analyzed for 1985 and 1990. All states provided production levels to be used for the analytical purposes of this environmental impact statement except two. The State of Colorado chose to specify production levels equivalent to the DOE mid-level estimates. The State of Utah preferred not to specify any production levels and indicated that the DOE estimates for Utah are extremely suspect.

3.1.7 Lease to Meet DOE Production Goals

Under this alternative, DOE regional production goals would drive the tract selection system. Although the same amount of leasing might result from some of the previously described alternatives, this alternative would focus specifically on the DOE national production projections and would not call for any adjustment in those projections. Areas acceptable for further consideration for coal leasing would be defined as under the preferred program. New leasing needs in a region

would be calculated by first estimating for a future period the difference between DOE production estimates and currently committed coal production. Estimates would then be made of the amount of coal needed to fill potential production gaps that could be supplied from existing Federal leases and non-Federal coal. Estimates of the potential production from existing leases and non-Federal coal would take into account unsuitability criteria and the relative costs of mining these sources of production. The remainder of the gap would then have to be met by coal production from new Federal leases.

Under this alternative, PRLAs would be processed as described under the preferred program. The amount of new competitive leasing planned for regions would be adjusted for the amount of reserves in PRLAs expected to be leased. The adjustment would take into account whether PRLA reserves were the least costly to mine, the type of coal needed, environmentally acceptable locations, and other factors.

This alternative would include an emergency leasing component. Environmental impact statements would be prepared as under the preferred program. Surface owner consent would proceed as specified in section 3.2.7.

3.1.8 Other Alternatives Not Considered

The EMARS I proposal is not separately analyzed as an alternative in this statement. The basic principal of EMARS I, that coal development on Federal lands should stem from government interests, is a primary factor in the lease-to-meet-DOE-production goals and in the preferred program, which relies on both coal need projections and ways to modify these projections in response to other conservation concerns, state government concerns, and other concerns. Other EMARS I elements were either never articulated or totally superseded by subsequent legislative changes.

The alternative of Federal interest development of coal resources is not discussed at all here. Although it was mentioned in the 1975 programmatic environmental impact statement, it is unlikely Congress would approve legislation removing the responsibility for taking coal development on Federal lands away from the private sector. The alternative is unreasonable and does not need to be analyzed.

3.2. DETAILED DESCRIPTION OF CERTAIN COMPONENTS OF THE PREFERRED PROGRAM

This section provides a more detailed presentation of certain components of the preferred Federal coal management program. It also includes a discussion of certain statutory requirements which have guided the designing of the preferred program. Figures 3-2, 3-3 and 3-4 display fully the major steps in the preferred program.

Each discussion of a component of the preferred program in this section notes where the component is unique to the preferred program and where it is compatible with other alternatives.

3.2.1. Land Use Planning.

As previously noted, in the preferred program the land management agencies' planning efforts, in both the land use planning and activity planning stages, are to provide the

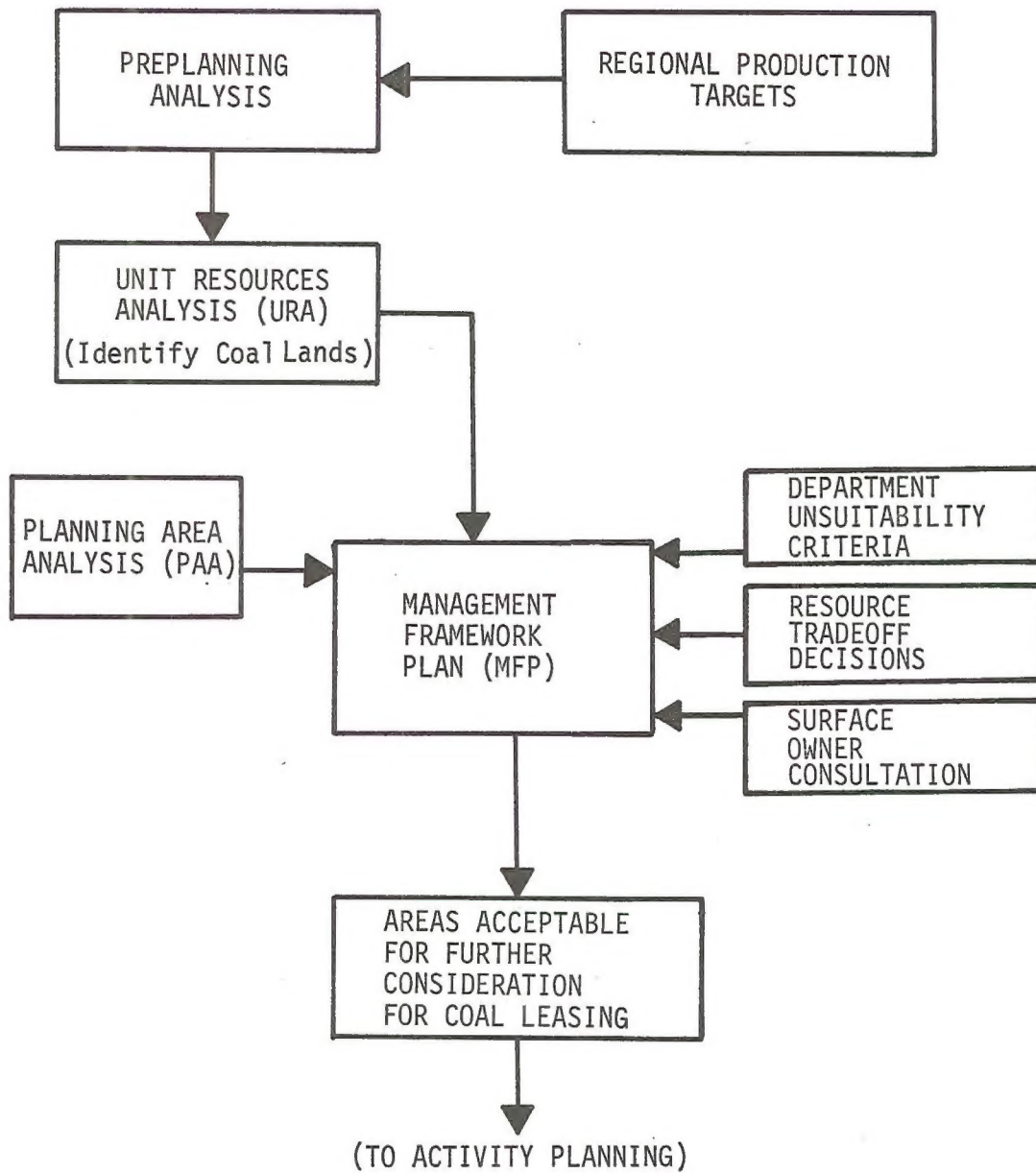


FIGURE 3-2

PREFERRED PROGRAM: CURRENT BLM LAND USE PLANNING PROCESS

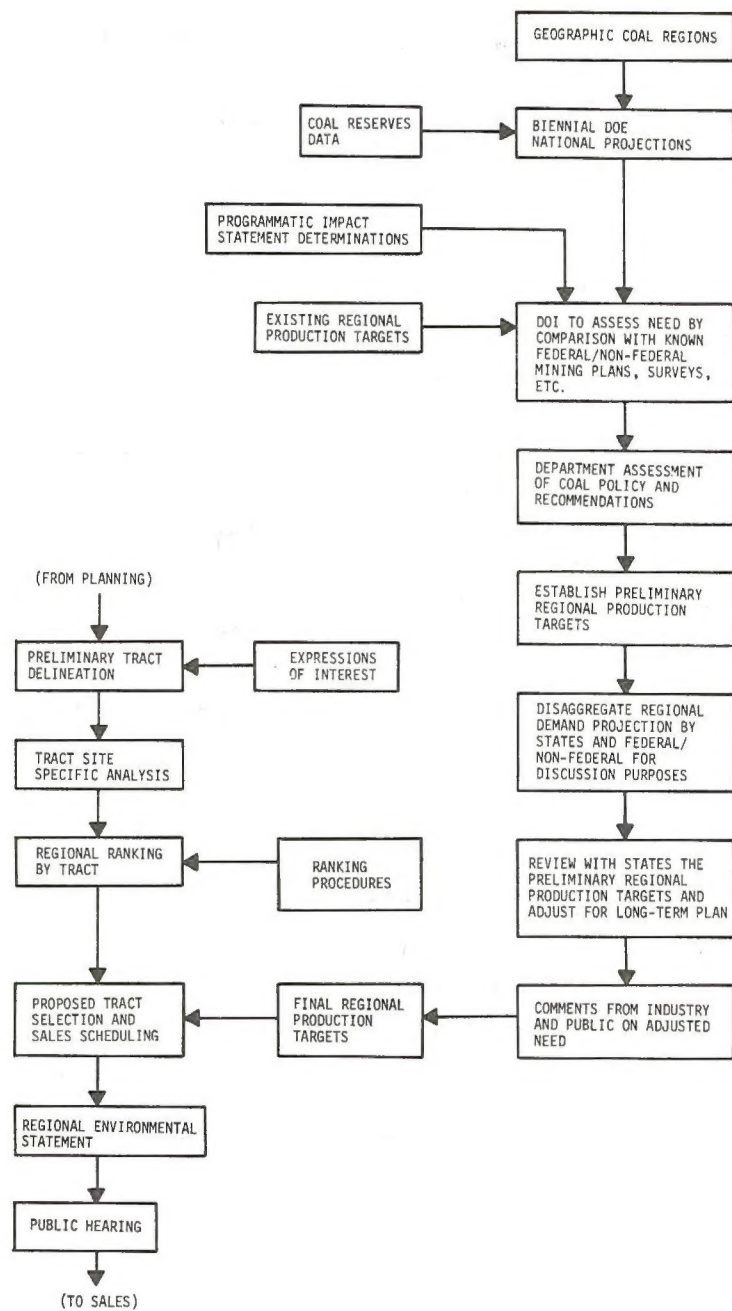


FIGURE 3-3
ACTIVITY PLANNING FOR PREFERRED PROGRAM

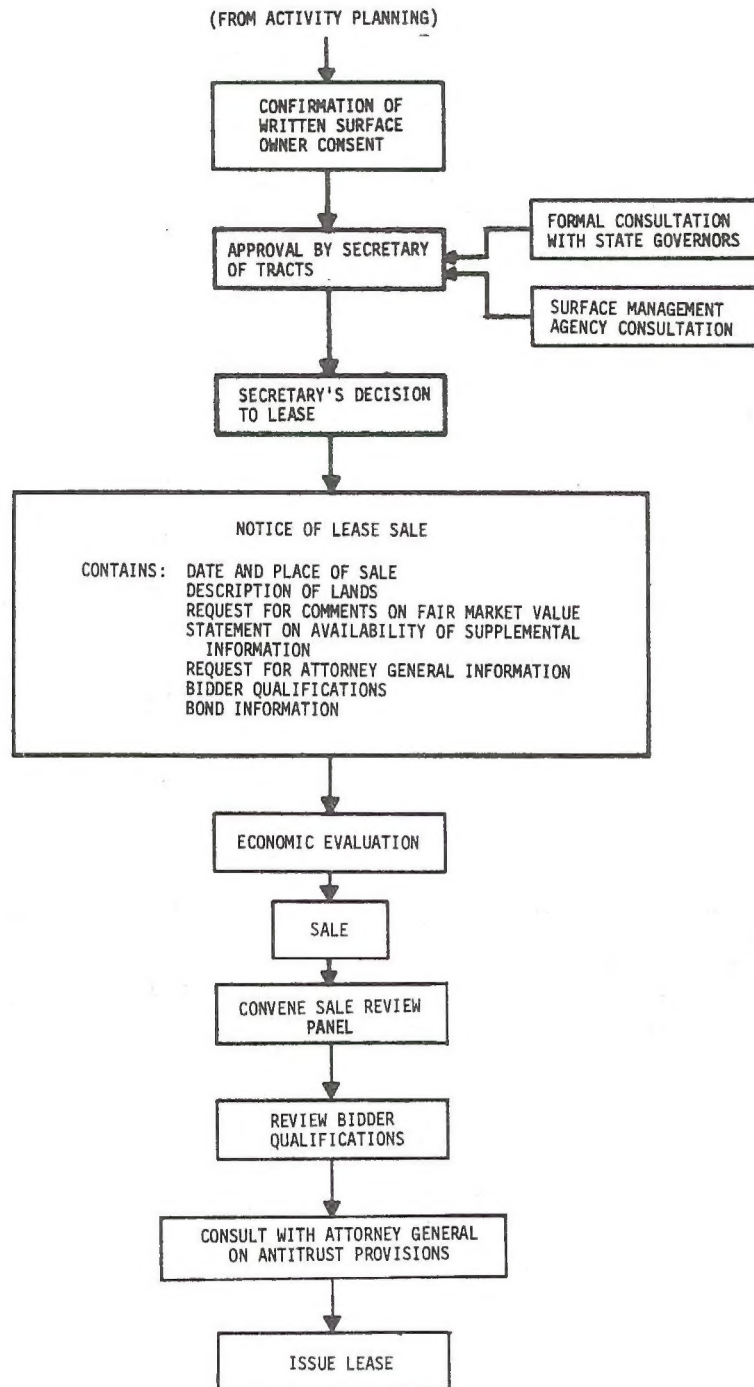


FIGURE 3-4

PREFERRED PROGRAM SALES PROCEDURES

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initiative and the forums for the making of the principal decisions in the Federal coal management program. This emphasis on planning is fully consistent with statutory requirements. Section 3(A)(i) of the Federal Coal Leasing Amendments Act of 1976, amending Section 2 of the Mineral Leasing Act of 1920, directs that "[no] lease sale shall be held unless the lands containing the coal deposits have been included in a comprehensive land-use plan and such sale is compatible with such plan." The Federal Land Policy and Management Act of 1976 established the basic planning authority for the Bureau of Land Management and the Multiple-Use Sustained-Yield Act of 1960 and the National Forest Management Act of 1976 provided planning guidance for the Forest Service. The guidelines in the Federal Land Policy and Management Act include:

- Inventory public lands, their resources and other values.
- Use multiple use and sustained yield concepts.
- Apply an interdisciplinary approach.
- Give priority to the designation and protection of areas of critical environmental concern.
- Consider present and potential uses of the land.
- Consider the relative scarcity of the values involved and alternative means and sites for realization of those values.
- Consider both long-term and short-term benefits.
- Provide for compliance with applicable pollution control laws.
- Coordinate inventory, planning, and management with other Federal agencies and state and local governments.

The products of both the Bureau of Land Management's and Forest Service's land use planning systems are comprehensive, multiple-use land use plans for discrete areas of Federal lands. These plans up to now have been called Management Framework Plans (MFPs) by the Bureau and Unit Plans by the Forest Service. The planning systems of the two land management agencies are broadly similar and are expected to be even more closely related when new planning regulations under the Federal Land Policy and Management Act of 1976 and the National Forest Management Act of 1976 are promulgated.

The Forest Service's proposed National Forest System Land and Resource Management Planning Rules were published on August 31, 1978 (43 Federal Register 39046-39059). The BLM's proposed planning regulations will be published prior to or simultaneously with this statement (43 CFR 1601). The description below of the BLM's planning system relates to the existing system. The revised system being proposed will differ in several ways from the existing system. These differences are designed to substantially improve the quality of land use plans and are explained in detail in the proposed planning regulations. They will not reduce the contribution of the land use plan to the coal program.

Structurally, the existing BLM planning system consists of four basic elements. The first is called the Unit Resource Analysis (URA). For each planning unit, a comprehensive inventory of resource problems and conditions, present resource uses, and existing resource values is prepared. This information is then analyzed to determine the existing

situation for each resource and the management potential for preservation, enhancement, and development of the resource.

The URA is considered with two other planning system elements, the Socio-Economic Profile (SEP) and the Planning Area Analysis (PAA) in developing the land use plans. The SEP is an information document which presents social and economic data in a systematic way. The PAA analyzes social, economic, environmental, and institutional values of significance to the management of Federal resources in the planning area.

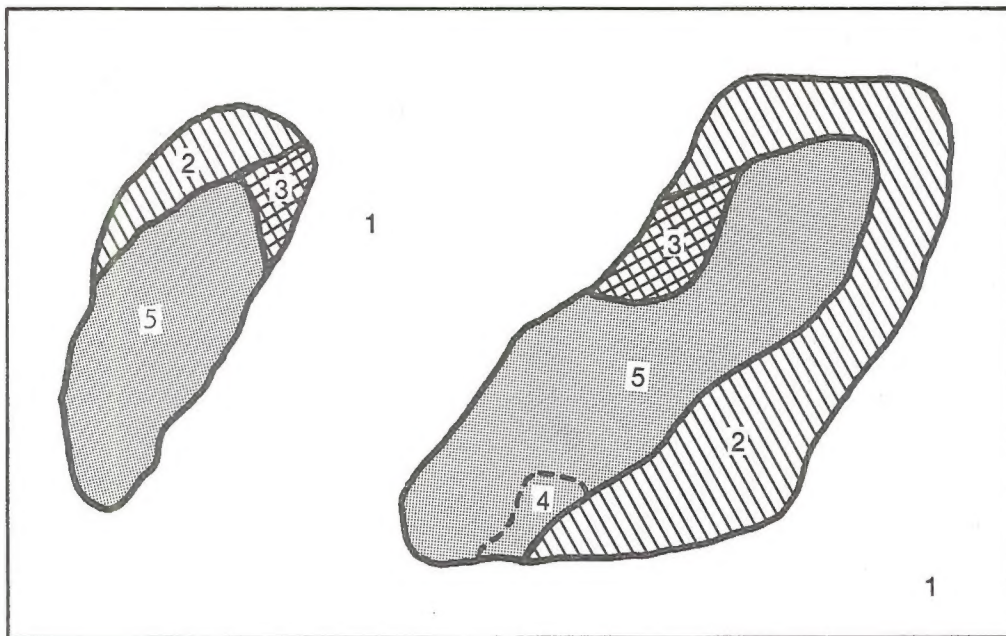
With this information base, the land use plans are prepared in a three step process. In step 1 of the process, the maximum potential for developing, preserving, or enhancing each resource is constrained by applying laws, regulations, and the demand levels of the PAA. In step 2, resource conflicts are identified and resolved so that final decisions can be made. In Step 3, the resulting land use plans identify preferred land uses, or combinations of uses, for the area and serve as guides to the Federal land managers. The land use plans establish the nature, extent, and objectives for future actions and programs on BLM-administered lands.

Under the Secretary's preferred alternative, the principal coal resource decision in the land use plan would be the determination of which areas are acceptable for further consideration for coal leasing. These areas would be identified after placing all lands in the system through four screens. Figure 3-5 indicates the steps which would be taken in the BLM's land use planning process:

1. Areas would be eliminated from coal development consideration which do not have high to medium coal potential.
2. Areas would be eliminated from coal development consideration based on application of lands unsuitability criteria.
3. Additional areas would be eliminated based on multiple use values identified and analyzed during conflict resolution. The adjustment at this stage would be made to accommodate unique, site specific resource values clearly superior to coal but not included in the unsuitability criteria. A prime recreation site or campground might be an example.
4. Areas may be eliminated where surface owners indicate definite preferences against the leasing of the deposits underlying the private surface. Application of this final screen would be at the option of the local land manager, and it would not be applied where a consent had previously been granted by the surface owner.

The remaining areas would be designated as areas acceptable for further consideration for coal leasing, subject to areawide constraints and multiple use coordination to guide coal program activities, such as maintenance of a minimal acreage of wildlife habitat conditions over the acceptable area, or other unique stipulations to be placed in any potential coal lease.

Preferred coal leasing areas might be identified if the areas acceptable for further consideration for coal leasing clearly are larger than may be needed for leasing before the land use plan would be updated (5 to 7 years), based on available socio-economic and demand data, and considering both coal potential and other conflicting values. Preferred area designations would be advisory only and not a plan commitment. They would assist the tract selection planning



Note: Areas are not shown in scale.

1. Areas eliminated because they do not have high to medium coal potential.
2. Areas eliminated because of application of unsuitability criteria.
3. Areas eliminated in resource trade-off planning decisions.
4. Areas eliminated as a result of surface owner consultation.
5. Areas shown in the land use plan to be acceptable for further consideration for leasing in subsequent activity planning.

FIGURE 3-5
TYPICAL MULTIPLE-USE PLANNING PROCESS

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team but would not necessitate a land use plan revision if the tract selection process results in the selection of tracts in other areas identified as acceptable for further consideration for coal leasing.

3.2.1.1 Unsuitability Criteria. The key activity added to the land use planning process in the preferred program is the application of lands unsuitability criteria.

The President, in a May 24 memorandum implementing his Environmental Message of May 23, 1977, instructed the Secretary of the Interior to lease "only those areas where mining is environmentally acceptable and compatible with other land uses." The President further directed that the Department "scrutinize existing Federal coal leases (and preference right lease applications) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications."

In addition, in August of 1977, the President signed into law the Surface Mining Control and Reclamation Act (SMCRA). Section 522 of this Act requires the Secretary to review Federal lands to determine whether there are areas which are unsuitable for surface coal mining operations. SMCRA also contains a requirement for the states to undertake a similar program if they wish to assume primary regulatory authority under the act. A list of standards to be used by the states is identified in Section 522(a)(3) of the act. Among these standards, which are also required to be applied to Federal lands (private surface lands overlying Federal coal are considered to be Federal lands for the purposes of the application of standards), are land reclaimability; fragile or historic lands; renewable resource lands, including aquifers; and natural hazard lands.

Under the preferred program, unsuitability criteria have been developed in response to Section 522 of SMCRA and the directives in the President's Environmental Message. The Department would not lease lands unsuitable for coal mining unless exceptions indicate mining should be permitted under certain conditions. The President's Environmental Message requires future coal leasing to be environmentally acceptable and compatible with other land uses. The intent of these criteria is to give the Secretary assurance that the Department would be fulfilling this responsibility in a consistent, uniform manner across all the Federal lands. They also would give him a means for judging the environmental acceptability of existing leases and lease applications.

The criteria are intended for application within the planning systems of the Federal land management agencies. They are intended to identify lands with key environmental features which make them unsuitable for coal leasing. These lands would be removed from the activity planning process of delineation, ranking, and selection of tracts for lease sales.

The unsuitability criteria selected by the Under Secretary for inclusion in the preferred program are set forth in Table 3-1. A task force representing ten agencies and offices in the Department of the Interior and the Forest Service, Department of Agriculture, conducted a comprehensive review of existing legislation, Presidential and Secretarial Orders, and Departmental policy and prepared a set of draft unsuitability criteria, with, in many cases, alternative criteria.

These criteria were field tested by four task force teams on Federal lands in four test areas in Montana, Utah, and Wyoming. The results of the field tests and the final set of criteria recommended by the task force appear in the task force's September 12, 1978, final report, *Land Unsuitability Criteria* (available upon request from the Department)[2].

The Under Secretary also expressed a preference as to how the unsuitability criteria would be applied in the land management agencies' planning systems.

The unsuitability criteria would, in some form, be applied to all new leases, including emergency leases and preference right lease applications. The criteria would be applied directly to the tracts for emergency and preference right lease applications. For all other new leases, the procedures set forth below would be followed.

The responsible official of the Federal land management agency would describe in the land use plan the results of the application of each of the unsuitability criteria to the planning area. He would state each instance in which a criterion is found to be applicable and show the area which is excluded from further coal development consideration, or, should he determine that the conditions for an exception exist, describe the area to which the exception applies and discuss in detail the reasons why the exception is made and what type of stipulations will be required in the lease or mining permit to assure compliance with the exception.

The responsible official would make his recommendation on the best available data that can be obtained given the time and resources available to prepare the land use plan. The description in the plan would explain whether additional data would be likely to significantly affect the conclusions reached about unsuitability. The plan would also disclose when in activity planning, lease sale, or post-lease activities the necessary data would be generated. At such time, the responsible official would be required to make public his determination concerning unsuitability and the reasons therefor.

All lands not designated unsuitable for coal mining would be considered further in the land use planning process. Lands with coal that would be mined by underground mining methods would not be considered unsuitable for coal mining where the mining would result in no hydrologic or surface effects. Where underground mining would produce hydrologic or surface effects on Federal lands to which an unsuitability criterion applies, those lands would be considered unsuitable unless the conditions exist to permit an exception. Surface effects include surface occupancy, subsidence, fire, and other environmental impacts of underground mining which are manifested on the surface.

After completion of the land use plan, the Department could exclude additional lands from further consideration for leasing when warranted by new information without formally revising the plan.

The new planning requirements and unsuitability criteria would also be applied to each existing non-producing lease upon submission of a mining plan by the lessee. The mining plan would be reviewed in light of the unsuitability criteria to determine which, if any, apply. If any criterion applies, the specific criterion and any exception to it which the conditions permit to be applied would be identified. If a criterion does apply and the conditions do not permit an exception, a further

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decision would be made on whether the land is exempt from the criterion because of the source of the authority for the criterion. Mining would be permitted on land to which no criterion applies; on land where a criterion applies but where the conditions permit an exception; and on land to which a criterion applies, no exception applies, but which is exempt from that criterion.

3.2.1.2. Multiple Use Resource Management Decisions. Although it is likely that most major conflicts between coal and other resources would be addressed during the application of the unsuitability criteria, significant resource balancing decisions could remain. These other resource trade-offs would be considered and acted upon after application of the unsuitability criteria. The adjustments at this stage in the land use planning process would be made to accommodate unique, site-specific resource values clearly superior to coal but which are not included in the criteria. A prime recreation site or campground might be an example.

3.2.1.3 Surface Owner Consultation. Section 714 (d) of the Surface Mining Control and Reclamation Act of 1977 requires the Secretary to consult during the planning process with certain owners of the surface estate overlying Federal coal resources being considered for leasing. This forms another screen for identifying lands that should not be leased.

In order to minimize disturbance to surface owners from surface coal mining of Federal coal deposits and to assist in the preparation of comprehensive land-use plans required by section 2 (a) of the Mineral Leasing Act of 1920, as amended, the Department would consult with any qualified surface owner whose land might be included in a leasing tract and ask the surface owner to state his preference for or against the offering of the deposit under his land for lease. It would also request disclosure of any consent for mining already given by the surface owner. The Department would, to the maximum extent practicable, refrain from leasing coal deposits for development by methods other than underground mining in areas where a significant number of qualified surface owners state a preference against the offering of the deposits for lease. Although sections of these areas might still be designated as acceptable for further consideration for coal leasing, the land use plan would contain the recommendation that no leasing take place in the areas, unless there are no acceptable alternative local areas available to meet an agreed upon target for the entire production region. If the individual surface owner indicates a definite preference against the leasing of the deposit underlying his surface, that deposit may be eliminated from further consideration for leasing. Should the surface owner not be willing to make a decision at this point, he would still be able to exercise his surface owner protection rights under the subsequent consent acquisition procedures of the preferred program (see section 3.2.4.1).

3.2.1.4 Threshold Development Levels. Although many land use decisions can be made on a site specific basis (as previously suggested, an area should be developed as a recreation site rather than leased for coal), many decisions may be oriented more toward impacts dependent on levels or rates of development. Although any one of several given potential coal development sites under consideration might have an acceptable impact by itself, the total impact to the area of developing all sites could be intolerable. As an

example, the crucial habitat area for a particular species might have been eliminated from further consideration for leasing. The species does, however, use additional areas within the land use planning area. Coal development in these areas might adversely affect the species' population. During the land use planning process, a decision that a 10 percent decrease in the population would be an acceptable trade-off might be made. Given the protection of the crucial habitat area, it might not make a difference what other areas would be temporarily lost to coal development as long as the total would not exceed a certain acreage or decrease the population more than the agreed upon amount. In this situation, no additional land would be removed from further consideration for coal leasing. Instead, a threshold constraint would be attached to specify the total level of production within the acceptable areas which would be consistent with the land use plan.

This threshold concept is particularly appropriate when considering socio-economic impacts. The social and economic infrastructure which coal development in the land use planning area would affect might, over a certain time period, only be able to support a certain development level. Also, the rate of development might be critical. If this information is available, a recommended threshold leasing or development level and rate could be specified in the plan.

It is not necessary to specify thresholds in the land use plan. The later steps in the leasing process supply ample opportunity for the Department, other Federal agencies, state and local governments, and others to discuss and agree upon regional and subregional thresholds. If, however, the land use planning process reveals the need for a particular threshold, then the decision could and should be made at that point.

All of the steps of this component could be made a part of any of the alternatives since land use planning must be done even if the Department decides not to adopt a leasing program. This component is least compatible with the alternative of responding to industry indications of needs particularly as it requires the land use planners to set threshold development levels. Under the industry indications of need option, the Department would reply on the market place to set the various threshold levels. Application of the unsuitability criteria would be postponed until the mine plan stage. Planning would focus only on those areas for which there had been nominations.

3.2.2 Activity Planning.

3.2.2.1 Tract Identification and Industry Expression of Interest. On completion of the land use plan, preliminary tracts would be identified within the areas designated acceptable for further consideration for leasing. In delineating the tracts, the land management agencies would consider the following factors:

- Technical coal data, including reserve tonnage, rank, sulfur content, seam thickness, and ratio of recoverable coal to reserves.
- Conservation considerations, including calculation of preliminary maximum economic recovery, land ownership patterns, and the formation of logical mining units.
- Expressions of interest and existing or planned operations on adjoining lands.

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- Surface ownership, including the results of surface owner consultation, and the existence of surface owner consents and their terms.

Although preliminary tract delineation would be done by the land management agencies, industry would first be requested to submit expressions of interest for leasing. A call for expressions of leasing interest would be made only after areas acceptable for further consideration for coal leasing have been identified in the Bureau of Land Management or Forest Service land use plans. In areas where state or other agency plans have been adopted, unsuitability criteria would be applied before a call would be made. The call would be made before setting of tract boundaries.

Any individual, business, or state or public body would be able to respond when the Secretary issues a call for expression of leasing interest. All calls would include a description of the kind of information required, including but not limited to location and quantities of coal desired, time needed, proposed use of coal, technical coal data, commitments with private surface owners and adjacent landowners or lessees, and basic development proposals. Public inspection and copying of information submitted with the expressions of leasing interest would be permitted in accordance with Departmental regulations.

Notice of each request for expressions of leasing interest would be published in the *Federal Register* and in the general circulation newspaper(s) in the region. This notice or request would specify the area or areas involved, information required, the period of time within which expressions may be submitted, where to write for further information, and where to submit the expressions.

The fact that a specific request for expressions of interest would be part of the activity planning system would not preclude industry, the states, or other parties from participating in the earlier land use planning efforts. General comments and interests could be submitted during the planning process or whenever any party might wish to indicate an interest in Federal coal in a particular area. General expressions of interest would be in the form of a letter to the Secretary. The Department would use this information for planning purposes or to aid in setting the regional production targets.

Tracts would not be identified as special opportunity lease sales for public bodies or small businesses during tract delineation. However, if special leasing opportunity sales are contemplated in the region, an effort to identify tracts of an appropriate size and location would be made at this stage of the process. In order to initiate Departmental action to identify potential public body tracts, interested parties qualifying as public bodies would have to submit formal expressions of interest in response to the appropriate request for expressions of interest. Although potential small business candidates would be encouraged to submit formal expressions of interest, they would not have to initiate tract identifications for small business special leasing opportunities. In consultation with the Small Business Administration, the Department would delineate tracts to go into the ranking process which could meet the needs of small businesses.

3.2.2.2 Regional Tract Ranking, Selection, and Scheduling. If the regional production target established for any given region

suggests the need for Federal coal leasing, a proposed lease sale schedule would be prepared. In the months before the schedule is established, all available preliminary tracts would be reviewed for the adequacy of the tract information profile. Data insufficiencies would be noted and, where time permitted, remedied so that each tract would have as complete a coal resource, socioeconomic, and environmental profile as possible. Also, unsuitability questions left unresolved in general planning would be analyzed and tract specific stipulations written at this time. Every two or four years, the Director, BLM, would begin the regional tract ranking and selection process. Ranking would be on a region-wide basis and not separately within each land use planning area. In the ranking process criteria relating to coal economics, ease of reclamation, proximity to existing transportation facilities, class of surface ownership (Federal or non-Federal), surface owner preferences, and socioeconomic and other environmental concerns would be employed. The ranked tracts would be compared with the desired level of production and a set of tracts would be selected for a proposed lease sale schedule. Since the potential environmental and social impacts resulting from development of any tracts in the same area would be cumulative, the selection of the first tract might preclude selection, or lower the priority of, other highly ranked tracts. Accordingly, as selections are made of individual tracts, the original rankings of the remaining tracts might be altered and the final, selected tracts would not necessarily directly correspond to the relative order in which the individual tracts were originally ranked. The number of tracts proposed would be dependent on the type of bidding system to be used (intertract or single tract bidding) and the tonnage targeted for lease. The selected tracts would be placed in a proposed regional lease sale schedule.

The ranking and selection process would be done by the Department in close consultation with the governors within whose states the region is located and in consultation with representatives of all affected Federal surface management agencies. The Secretary would invite comments from and participation of the public, industry, and other interested parties before making tract ranking and selection decisions.

A notice of intent to rank and select tracts to be included in a proposed regional lease sale schedule would be published in the *Federal Register* and selected general distribution newspapers within the region not less than 30 days before the ranking process begins. The notice would contain a description of the tracts to be ranked and procedures under which any interested parties are to be involved in the process. Also a final call for surface owner consent filings would be made for that sale schedule.

The results of the process, including the tract rankings, the tracts selected, the proposed schedule, and the list of ranking criteria would be published after the preliminary lease sale schedule and feasible alternatives have been approved by the Secretary. Detailed profile information on each of the tracts ranked would be available for inspection in the Bureau of Land Management offices in the region. Those parties interested in commenting on the results of the tract ranking and selection process would have the opportunity to do so in the regional sale environmental impact statement before any final decision would be made by the Secretary to hold a lease sale encompassing any of the selected tracts. It is the intent of

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the Department that the development of the regional sale schedule and the environmental impact statement on the regional sale be closely integrated. This would be done by integrating the decision and analyses documents used for sale schedule development with the statement. Some special efforts will be needed for the statement alone after preliminary identification of a sale schedule, but this work would be limited.

The tract ranking and selection process would normally be reconsidered every two years in accordance with the updating of the national and regional production targets. The Secretary might, in consultation with the governors of the affected states, initiate or postpone the process to respond to considerations such as major planning updates, new preliminary tract delineations and increases or decreases in the level of leasing.

To establish planning and inventory related priorities, the Secretary might include in the ranking process areas recently designated as areas acceptable for further consideration for coal leasing which have not yet been delineated as preliminary lease tracts. All tracts subsequently identified for lease consideration would be formally entered into the ranking and selection process before they are included in a lease sale proposal.

Activity planning would not occur under a no leasing alternative and would have relatively little importance under the preference right lease application and the emergency lease only alternatives. Under the industry indication of need alternative, activity planning would take place only in response to industry nominations and regional tract ranking and selection would not occur. The process described here would be consistent with the lease to meet DOE production goals alternative. Under the state determination of leasing levels alternative, the control over activity planning would be transferred from the Bureau of Land Management to the states.

3.2.3. Setting Regional Production Targets.

The major coal bearing areas of the continental United States have been divided into 12 coal production regions as shown in Figure 1-1. Eight of these regions contain significant reserves of Federal coal. Under the preferred program, these eight regions would serve as the basic units both on which the assessment of desired levels of leasing would be centered and in which tracts would be ranked and lease sales conducted. The Department of Energy, pursuant to the responsibilities assigned to it by the Department of Energy Organization Act, would establish and biennially update a national coal production target. Under the preferred alternative, the near and medium term DOE national production targets would serve as a guide for judging national need for Federal coal development.

After subtracting the production expected from the four regions not containing significant reserves of Federal coal from the national target, the Department would review and, if necessary, adjust the total, disaggregating it into the eight regions containing Federal coal. For each region, preliminary targets would be developed for total regional production and for production from new logical mining units which are made up of or include including Federal leases. This review,

adjustment, and disaggregation process would take into consideration statutory policies and land management requirements, the analyses in the Federal coal management programmatic environmental impact statement, and subsequent post-programmatic environmental impact statements on the delineation, ranking, and selection of tracts in each region; industry surveys; and information developed by other institutions and organizations. Final regional production targets would be established by the Secretary only after the states have been consulted and the public and industry have submitted comments on the preliminary targets.

The preliminary regional production targets would be used by the Federal and state governments to set data gathering and planning priorities to ensure that a sufficient number of tracts would be delineated and that adequate site-specific information would be available to make the regional ranking and selection process workable. These preliminary regional targets would also serve as initial guidance for the ranking and selection process. They would be flexible, however, with the final targets actually being developed as part of the analysis in the ranking and selection process.

Although the regional production targets developed at this stage would be preliminary, the process would still be quite important. The regional ranking and selection process should consistently indicate the optimum tracts for the desired level of development and lead to a thorough analysis of the impacts of alternative tract selections, including the alternative of choosing a combination of tracts which would result in the lowering of the production target. In the regional ranking and selection process, the possibility of trade-offs in production targets and lease tracts between regions cannot be adequately analyzed. This must be analyzed at the time the regional targets would be set or updated. The first time the process of determining regional production targets would be conducted, the interregional analysis conducted in this programmatic environmental impact statement would be used as a basis for the decisions on the targets after providing for state consultation and public comment.

In the subsequent updates of regional targets, scheduled to follow the biennial submission of DOE national targets, the information and analyses generated in the proceeding regional tract ranking and selection process would provide useful information for the target decisions. In the previous ranking and selection process, alternative tracts to the ones finally chosen would have been analyzed. Those highly rated but previously unselected tracts would most likely serve as an important pool of tracts for the selection of tracts to meet the new regional production targets. If the unchosen tracts remaining in one region are clearly superior to most of those remaining in another, consideration of interregional trade-offs in the setting of the new regional production targets would be appropriate. This overall interregional analysis of the tracts makes the development or update of the regional production targets at this stage quite important.

This component would be followed only under this alternative. Under the no leasing, preference right leasing, and emergency leasing alternatives, it would not be needed. It is incompatible with the industry indications of need alternative which relies on industry nominations to resolve the question of leasing levels. Similarly it is incompatible with the lease to meet DOE production goals and the state determination of

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leasing levels alternatives which rely on DOE and the states, respectively, to set the levels of development.

3.2.4. Pre-Sale and Sale Procedures

From the time a tract is selected for sale, at the conclusion of the activity planning stage, until a lease can be issued, a series of actions would be required to meet various statutory and administrative requirements.

3.2.4.1. Split Estate Leasing and Surface Owner Consent. Under the original homestead laws, ranchers and farmers were granted both the surface and mineral rights to their land, but later homestead laws provided for the Federal Government to retain the mineral estate. The majority of split estates originated out of entries made under these later homestead laws. The retained mineral estate included the right to enter and mine at any time in the future. The private landowner did not have the power to prevent mining, though he was guaranteed some degree of indemnification for damage.

Section 714 of the Surface Mining Control and Reclamation Act of 1977 provides that, in cases where Federal coal is overlain by private surface owned by a special class of owners, the Secretary will not issue a coal lease for surface mining purposes unless the "surface owner" has granted, in writing, valid consent to conduct such mining operations. Members of this special class of owners (hereafter referred to as section 714 owners) are defined as persons who:

- Hold legal or equitable title to the land surface.
- Have their principal places of residence on the land or personally conduct farming or ranching operations on the affected land or receive a significant portion of their income from farming or ranching on the affected land.
- Have met these two conditions for at least three years prior to granting the consent.

The section further provides that valid consents granted prior to the date of the act (August 3, 1977) will be deemed sufficient for complying with the section regardless of the consents' terms.

In cases of leasing for either underground mining or surface mining where the non-federal surface is not owned by a section 714 owner, the consent provisions of the statute under which the surface was patented (with the coal reserved to the Federal government) would govern. The most important of these laws is the Stock-Raising Homestead Act (30 U.S.C. 299) which states at section 9:

... Any person who has acquired from the United States the coal ... in any such land, or the right to mine and remove the same, may reenter and occupy so much of the surface as may be required for all purposes reasonably incident to the mining or removal of the coal ... first, upon securing the written consent ... of the homestead ... patentee; second, upon payment of the damages to crops or other tangible improvements ...; or, third, ... upon the execution of a good and sufficient bond

Several issues were raised in considering how section 714 might affect the structure and implementation of a Federal coal management program. The questions are not trivial; of the 9.7 million acres of Federal lands classified as containing technically recoverable coal in the six principal western coal states 6 million acres are overlain by private surface (see Table 2-5). Of course, the amount of private surface with qualifying

section 714 owners will be much less than the full 6 million acres.

The legislative history of section 714 was stormy. The measure was proposed to protect the property of farmers and ranchers who face the risk of being moved off their land to make way for surface mining. The Congress considered amendments expressly limiting compensation, and the Senate version of SMCRA empowered the Secretary to override the surface owner if leasing would be in the national interest. The provision agreed to by the Conference Committee, and signed by the President, however, included no compensation limitation or override.

SMCRA does stipulate that Federal coal underlying the private surface is to be leased in accordance with the Mineral Leasing Act of 1920, as amended. This law prohibits the government from accepting any bid which is less than the fair market value of the coal, as determined by the Secretary. According to the Department's Office of the Solicitor, "... the conflicts between surface owner consent and the Secretary's obligations under the Mineral Leasing Act are ... subject to reasonable regulation under the terms of section 32 ... , 30 USC 189, which provides, 'The Secretary ... is authorized to prescribe necessary and proper rules and regulations and to do any and all things necessary to carry out and accomplish the purposes of this (act)' [3]. Two purposes of the 1920 Mineral Leasing Act, as amended, are to ensure that leases are sold on a competitive basis and that fair market value is received for the coal. The act is interpreted as giving the Secretary the authority to regulate the leasing process to meet these purposes. Specifically, the Secretary may monitor surface owner consents to ensure their form and financial terms do not substantially affect fair market value or the competitive nature of the lease sale and, should these terms threaten the public interest, decline to proceed with that lease sale or to execute the lease.

Therefore, the guiding principal in interpreting the possible consequences of section 714 is that, even if consent has been given, the section does not prohibit the Secretary from exercising his discretion not to lease.

Tracts would be delineated and ranked regardless of the ownership of the surface. Areas may be excluded from this process through the land use plan if the surface owner has clearly established in surface owner consultation during the land use planning process that he or she does not want his surface subjected to surface mining. In the selection of tracts for sale, a preference would be accorded tracts where the surface is federally owned in favor of tracts where the surface is in private ownership (other factors being nearly equal) and tracts where BLM has received evidence of consent by the time of ranking over tracts which still require consent.

Industry would be responsible for acquiring surface owner consent for the mining of tracts of Federal coal whenever such consent is required by section 714 of the SMCRA before a lease can be executed. Consents would be required to be filed with the BLM prior to the sale announcement. Industry (as well as the States and the public) would be supplied with the preliminary tract ranking to give potential bidders an indication of the likelihood certain tracts would be scheduled for sale in the coming four years. Industry would be encouraged to advise the BLM when consent negotiations fail so that unnecessary site specific analyses

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would not be undertaken. If no filing of consent is made on a tract before the notice of sale, the tract would be removed from the sale schedule (and, if necessary, another tract substituted for it). The Secretary, however, might determine to continue a tract without consent if it is considered important. In this case the successful bidder on that tract in the sale would be given a period of time after the sale to obtain surface owner consent. If the bidder is successful in obtaining consent, the lease would be executed; if not, the sale of the lease for that tract would be voided. consent compensation costs would be required in the determination of fair market value for the lease sale.

Any tract containing an area to which applies a surface owner consent negotiated after the enactment of SMCRA would be placed in the sale only if the consent is transferable to any third party. A surface owner consent agreement would be considered transferable only if it provides, in part, that after the lease sale (1) the payment for the consent is to be made by the successful bidder directly to the section 714 owner or (2), after the lease sale, the successful bidder is automatically permitted to acquire the consent by reimbursing the company which first obtained the consent for its original purchase price.

Tracts which are selected for lease sale and which include areas covered by consents given prior to SMCRA would be offered for sale if the consents are determined to be transferable. If any pre-existing consent is determined to be non-transferable the tract would not be offered for sale unless it is included in an intertract sale.

3.2.4.2 Lease Stipulations. The Department would conduct an environmental analysis for each proposed lease to develop lease terms and stipulations. The information on which this report would be based must be sufficiently detailed so that the Department could be reasonably certain that the lease would be economically and environmentally acceptable, but in less detail than would be required of a lessee at the time a mining plan would be approved.

3.2.4.3 Fair Market Value. The Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976 (FCLAA), specifically mandates that, "No bid shall be accepted which is less than the fair market value, as determined by the Secretary, of the coal subject to the lease."

The basic method for evaluating fair market value would be discounted cash flow analysis. The discounted cash flow analysis involves calculating annual costs and income resulting from the development of a property under realistic conditions. This method is currently being used by the Department to determine fair market value for those tracts being leased under the *NRDC v. Hughes* agreement.

Before the Secretary makes any final determination on fair market value, the public would be given the opportunity to comment. Comments would be solicited on fair market value consideration for any tract being offered, as well as on the related decision of maximum economic recovery.

3.2.4.4 Sale and Bidding Methods, Due Diligence Requirements. For the preferred program, the Secretary has recommended that sale and bidding method regulations be kept flexible, permitting the choice of method to be on a case-by-case basis.

Leases would usually be sold using the individual tract sale method, bidders compete against one another for any given tract. The Department would choose which tracts it feels are the best tracts, both economically and environmentally, and which cumulatively contain the amount of coal reserves desired for lease. These tracts would be offered for sale over the four years of the regional sale schedule. The highest bidder in any sale would be offered the tract provided his bid meets fair market value, passes the Attorney General's anti-trust review, and meets all other requirements of the laws.

Coal leases could also be sold using the intertract sale method, with bidders competing between tracts as well as over individual tracts. This is likely, for example, for tracts containing pre-existing surface owner consents. More tracts would be offered than are intended to be awarded. The high bids for each tract would be compared, and only those tracts with the highest bids which are needed to meet cumulatively the sale's target would be awarded. The high bidders would also, of course, have to meet all necessary requirements of the law including fair market value. As under individual tract bidding, the tracts for the sale offering would be selected on the basis of land use planning, subsequent site specific analysis, and tract ranking.

Regardless of whether the intertract or individual tract sale method is used, the type of bidding method must also be determined. Optional methods include:

- Direct bonus bidding: an immediate cash payment is offered for the lease. (Note, the Federal Coal Leasing Amendments Act of 1976 requires half of all sales to be by deferred bonus bid.)
- Royalty bidding: the value of a fixed percentage of the coal is offered for the lease (usually a small cash down payment is also required).
- Sliding scale royalty bidding: the amount of the royalty paid is varied in proportion to the value of the coal produced.
- Profit sharing method (British system): the government under this system essentially becomes a partner in the coal enterprise and receives a percentage of profits, if any.
- Fixed rental: the bidder offers to pay the government a set amount each year regardless of production.

The current regulations (43 CFR 3500.05) define diligent development for any coal lease issued after August 4, 1976, as the timely preparation for, and initiation of, coal production from a logical mining unit (LMU) of which the lease is a part so that the coal is actually produced at the rate of one percent of the reserves in the LMU by the end of the tenth year from the effective date of the lease. Diligent development for any lease issued prior to August 4, 1976, is defined as the timely preparation for, and initiation of, coal production from the LMU so that the coal is actually produced at the rate of one-fortieth of the LMU reserves before June 1, 1986. Under the regulations, the period of time for the latter leases may be extended.

Although the authority to promulgate regulations concerning diligent development, bidding methods, and royalties was transferred to the Department of Energy in the Department of Energy Organization Act. Should DOE not promulgate new regulations before a Federal coal

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management program is established, the current regulations would remain in force.

Timely production of coal is further assured through the "continuous operation" regulations. Under these regulations as now written coal equal to one percent of the reserves of the logical mining unit must be produced for each of the first two years following achievement of diligent development. Thereafter, an average amount of one percent of the reserves associated with the lease must be produced. The average amount is computed over a three year period consisting of the year in question and the preceding two years.

3.2.4.5 Consultation with the governors. Prior to setting a regional coal sale schedule, the Secretary would consult the governor of the state in which the land to be leased is located. The Secretary would give the governor a specified period of time to comment, not less than 30 days nor more than 60 days, before issuing the final schedule of sale. The Federal Coal Leasing Amendments Act of 1976 provides a specific procedure for consultation with a state when a lease proposal would permit surface mining within the boundaries of a National Forest within that state. The governor would be notified by the Secretary. If the governor fails to object to the lease proposal in 60 days, the Secretary could issue the lease. If, within the 60-day period, the governor notifies the Secretary, in writing, of an objection to the lease proposal, the Secretary would not approve the lease for six months from the date the governor objects to the lease. The governor could, during this six-months period, submit a written statement of reasons why the lease should not be issued, and the Secretary would, on the basis of this statement, reconsider the lease proposal.

These procedures are compatible with all alternatives, although they will have no applicability to the no leasing and preference right leasing only alternatives.

3.2.5 State, Local, And Industry Participation.

A variety of methods have been developed to provide state, local, and industry participation in the Federal coal management process.

3.2.5.1 State Participation. The preferred program has been designed to emphasize the role of the state governments in the Federal coal management process short of providing them veto power over Federal decisions. The states would be offered the opportunity to sign cooperative agreements on land use planning enabling them to directly participate in the land use planning efforts. The states would be expected to participate actively in the activity planning procedure of tract ranking and selection and sale planning procedures of scheduling. Furthermore, a special consultation step would be provided to the states in setting regional production targets. The governor would also be informally consulted prior to any final decision to offer a tract for sale. Although the states would be expected to provide their views over the full spectrum of issues, the Department would particularly need the states' comments on the interregional and cumulative regional social and economic impacts of coal development in the regional production targets setting process and on intraregional and site-specific social and economic impacts in the tract ranking and selection process.

3.2.5.2 General Public Participation. The public would have several opportunities to participate throughout the coal management decision-making process. Hearings would be held on the land use plan recommendations before the final land use plan decisions would be made. Comments would be solicited from the public at the beginning of the regional tract ranking and selection and sale scheduling process. The public would have the opportunity to submit written comments and to participate in a hearing on the regional sale environmental impact statement. The Secretary could also hold additional hearings in the area of the proposed sale if there were general interest in the proposed sale and any issue existed which had not been thoroughly discussed at previous hearings. Besides the general public participation steps, there would be opportunities for participation concerning surface owner consultation, surface owner consent, and indications of leasing interest.

In addition to these formal opportunities for public participation, anyone could submit general comments at any time in the process. The Department would schedule meetings for public comment whenever it has reason to believe that it would serve the public's interest.

3.2.5.3 Industry Participation. Industry is a critically important actor in the preferred alternative Federal coal management program not only because it supplies the bidders in the lease sales and the technology and capital to extract the coal, but also because it provides information needed in the determinations leading to the delineation of tracts. The three principal sources for coal information in the United States are the Federal government, through the Geological Survey and other agencies; the state governments, through the state geological surveys or mining bureaus; and the coal industry. Industry is in a special position to make the Federal government aware of the type, quality, quantity, and location of coal which it believes should be considered for leasing.

Industry would be able to participate in the land use planning and regional production target setting process through all the same formal and informal channels available to the general public. During land use planning, industry could contribute information on existing operations and on the location of resources. During the setting of regional production targets, industry could supply information on the overall demand for coal and the production potential from previously leased Federal reserves and non-Federal reserves for meeting that demand. In addition to these general participation opportunities, industry would have the opportunity to supply specific data in the activity planning process.

As previously noted, the activity planning process for coal would involve the delineation, ranking, and selection of tracts within areas identified as acceptable for further consideration for coal leasing in the land use plan. Information derived from industry data would be required to assist in determining need and to facilitate lease tract delineations and economic evaluations.

To obtain this data, industry would be asked for formal expressions of interest within the areas acceptable for further consideration for leasing set out in the land use plans. These expressions would be used in the tract delineation and ranking

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processes. The types of information which might be requested would be:

- Written descriptions of land by legal subdivision and a map with a scale of one-half inch or larger.
- Amount of coal desired including such geologic data on the area as bed thickness, overburden depth, and thickness of coal seam(s).
- Method of mining anticipated, with proposed mining sequence and rate of production.
- Relationship, if any, between the anticipated mining operations and existing or planned mining operations or supporting facilities on adjacent Federal or non-Federal lands.
- Anticipated method(s) of transportation and status of proposed system.
- Evidence of qualifications.
- Intended "end use" of coal.
- Consent certification if the surface is not owned or controlled by the Federal government.
- Description of adjacent coal reserves under ownership or control of the company providing the expression of leasing interest.

These components would not be compatible with the no leasing or preference right leasing alternatives and would be used only to a limited extent under the emergency leasing alternative. Under the industry indications of need alternative, greater emphasis would be placed on obtaining, at an early stage, industry nominations and less emphasis would be placed on state consultation. Under the state determination of leasing levels alternative, the role of the states would obviously be pre-eminent. On the other hand, in the lease to meet DOE production goals alternative the role of industry and the state would both be reduced.

3.2.6 Special Leasing Opportunities.

In response to the requirements in the Federal Coal Leasing Amendments Act of 1976 and the Small Business Act of 1953, as amended, the Department would reserve and offer a reasonable number of coal lease tracts as special leasing opportunities. The special opportunities would consist of holding special lease sales where public bodies would bid only against other public bodies and small businesses against other small businesses. No special determinations of fair market value, maximum economic recovery, or other possible financial incentives would be proposed.

Public bodies are non-profit consumer-owned utilities, principally rural electric cooperatives and municipal owned utilities and Federal agencies. Secretary would designate certain coal lease tracts for special opportunity lease sales for public bodies after the ranking and selection process only if a public body had requested during the planning or expression of interest processes that it desired a special opportunity lease sale be held. At the time of submission of this request, the public body would have to submit evidence of its qualifications to participate in a special opportunity sale.

Small business would be required to meet the qualifying standards set forth in 13 CFR 121. In brief, to qualify a small business must be independently owned and operated, not dominant in its field, and, together with its affiliates, employ not more than 500 employees. Although it would be advisable

and to its advantage to do so, a small business would not be required to notify the Department of its desire for a special opportunity sale. The Secretary's decision to hold a small business special opportunity sale would be made in consultation with the Small Business Administration.

This element would apply to all but the no leasing and preference right leasing only alternatives.

3.2.7 Emergency Leasing System.

The emergency leasing system would enable the Department to meet urgent needs for Federal coal which could not be dealt with in a timely manner through the normal long term leasing process. The emergency leasing system would differ from the normal long term leasing process only with respect to (1) the method of tract identification and (2) the breadth and scope required in the planning and environmental assessment process. This system would be administered to maintain the integrity of the normal long term leasing process.

Each applicant under the emergency leasing system would be required to show that either:

- His is an existing mining operation which had been producing coal for at least two years before the date of application; and
- The Federal coal is needed within three years to sustain an existing mining operation at the average annual level of production or new committed level of production on the date of application, as substantiated by a mining sequence plan and projected production levels, or
- In an existing mining operation, the requested Federal coal would be bypassed if not mined. Further, some portion of the bypassed coal would be mined within three years as substantiated by a mining sequence plan and stated proposed production levels, or
- The Federal coal would be mined within three years in the process of obtaining economic access for development of private or leased coal.

In addition, the applicant would have to show that the need for coal, except in certain cases of bypassed coal, had resulted from circumstances beyond the control of the applicant or that he could not have reasonably foreseen and planned for in time to enable the Department to respond through the normal long range tract selection process.

The tract to be offered for the emergency lease sale would only be so much of the land applied for as would be necessary to meet the emergency need of the applicant without violating the integrity of the normal long term leasing process.

No coal lease would be issued unless a comprehensive land use analysis has been conducted on, and the Department's unsuitability criteria have been applied to, the land to be included in the lease. All emergency leasing decisions would have to be consistent with the appropriate land use plan or analysis and the unsuitability criteria.

Before a lease sale would be held in response to an emergency lease sale application, an environmental analysis would be completed on the potential effect of such a coal lease on the resources of the area and its environment, including fish and other aquatic resources, wildlife habitats and populations, visual resources, recreation, cultural, and other

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resources in the affected area. Should the Department determine an environmental impact statement is required, one would be completed.

The pre-sale and sale procedures, including public participation procedures, of the normal long term leasing process would be followed in all emergency leasing situations.

This would be the major component of the emergency leasing only alternatives. It could also remain a component of the lease to meet DOE production goals, industry indications, of need and state determinations of leasing level alternatives.

3.2.8 Start-up Special Considerations.

The preferred program is designed as a start-to-finish-pre-land use planning to post-mining use system of Federal coal management of new competitively-sold coal leases. Much of the general resource inventory and land use planning required under the procedures described above will have been completed or will be well begun by the date of publication of the final version of this statement. Assuming that, upon review of the final version of this statement, the Secretary decides that, first, a new Federal coal management program is required; second, the program should be identical or similar to the preferred program presented herein; and, third, a lease sale or sales should be held, the new program would be integrated into the existing planning system as follows:

- For all areas on which coal-related planning has not been conducted, the inventory process would begin. Coal-related planning areas would be selected based on priorities established after the initial regional production targets have been established.
- For all areas on which land use plans have been completed, the land use decisions would be re-examined on areas or tracts identified as appropriate for coal development (areas on which coal development would be consistent with the plan). The unsuitability criteria would be applied to these areas or tracts. If unsuitability for coal mining has not been determined, and if surface owner consultation has not occurred, where applicable, these steps would be taken. Those areas or tracts which are not determined unsuitable would then, after a public hearing, enter the activity planning and regional sale environmental impact statement process.
- Because of the limited resources of the Department, the first lease sales might not be conducted in all regions for which the regional targets suggest leasing is needed and might be insufficient to meet the targets for the regions in which they are held.
- The early regional lease sale environmental impact statements would likely address a two-year rather than a full four-year sale schedule.

3.3 ISSUES AND OPTIONS

3.3.1 Decision Process

As was mentioned, the preferred program was developed out of expressions of preference among a series of policy options made by the Secretary and Under Secretary between October, 1977, and November, 1978. A first step in most of the decision processes was the convening of a task force assigned

to the specific issue area. These task forces were staffed with coal and other specialists drawn mostly from within the Bureau of Land Management, the Geological Survey and the Office of Policy Analysis. The product of each task force was a background issue paper. These papers were reviewed and from them concise issue option papers were prepared by the office of Coal Leasing, Planning, and Coordination. The papers presented to the Secretary are listed in Table 3-2.

All issue option papers were circulated to the Assistant Secretaries of the Department of the Interior for comment. After meeting with the Assistant Secretaries and receiving their comments, as well as any additional clarifications he needed, the Secretary or Under Secretary selected his preferred policy options. The issues and options considered by the Secretary and Under Secretary and their preferences are summarized in Table 3-3.

3.3.2 Program Structure Issues

3.3.2.1 Coal Industry Information. The first issue forwarded to the Secretary in the Federal coal policy review was: when in the planning process should the Department solicit information from the coal industry regarding where they would prefer to have leases offered? The options were framed around the assumption that the land management agencies' planning systems would provide the framework for making multiple resource, interdisciplinary land use decisions.

The preferred option is to use the planning process to designate areas acceptable for further consideration for leasing within the planning area's coal fields before industry resource and market information would be solicited. Industry information would be used to aid in the tract delineation, ranking, and selection process. The Secretary selected this option ("industry's tract interest would be expressed after the Department has determined acceptable areas") with the understanding that industry's comments would be welcomed and would be solicited concurrent with public comments in the land use planning process.

3.3.2.2 Levels of Leasing. Subsequent to the Secretary's expression of preference concerning industry participation in coal leasing decisions, the next issue raised was that of the need for new leasing and, assuming that there are preliminary indications of need, what should be the general structure of a new Federal coal management program. These options provide the framework for this environmental impact statement.

Over the past several years the question of the need for leasing has been a focal point of much of the controversy surrounding the Department's efforts to manage Federal coal resources. Considering the several years' lead time needed for developing mines to the point of production and the similar time frames for planning and constructing coal-consuming power plants, precise determinations now of the tonnage of Federal coal which should be leased to meet the Nation's future energy requirements are not feasible, although estimates can be made on the basis of available information and projections.

Chapter 2 of this document provides an examination of the national energy role of western coal, including an assessment of the need for leasing. The need for leasing involves both meeting national energy objectives and

TABLE 3-2
ISSUE OPTION PAPERS

Issue Option Papers*	Paper Date	Decision Date
Option Paper for the Secretary: Departmental Approach for the Long- Term Coal Leasing Program	Sept. 20, 1977	Oct. 26, 1977
Need for Leasing/Leasing Systems Choice	June 23, 1978	June 30, 1978
Bidding Systems	June 23, 1978	June 30, 1978
Setting of Environmental Conditions and Lease Terms	June 23, 1978	June 30, 1978
State and Local Government Participation	June 23, 1978	June 30, 1978
Public Participation	June 23, 1978	June 30, 1978
Maximum Economic Recovery	June 23, 1978	June 30, 1978
Coal Leasing: Surface Owner Consent	June 23, 1978	June 30, 1978
Leasing for Limited End Uses	June 23, 1978	June 30, 1978
Public Body Leasing	June 23, 1978	June 30, 1978
Management of Preference Right Lease Applications	June 23, 1978	June 30, 1978
Management of Existing Leases	June 23, 1978	June 30, 1978
Intraregional Matters Affecting Design of a Leasing Process	July 18, 1978	July 28, 1978
Environmental Analysis Strategy	Aug. 31, 1978	Sept. 15, 1978
Split Estate Leasing Implementation	Aug. 31, 1978	Sept. 15, 1978
Land Unsuitability Criteria	Sept. 22, 1978	Oct. 3, 1978
Proposed Additional Unsuitability Criteria	Oct. 30, 1978	Nov. 2, 1978

*All issue option papers are available from the Department upon request.

TABLE 3-3
POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS (a)	PROS AND CONS (b)	PAPER AND DATE/COMMENTS
<p>When during the planning process should the Department solicit information from the coal industry regarding where they would prefer to have leases offered?</p> <p>1. Before multiple-use tradeoff and unsuitability decisions are made.</p> <p>2. Do not solicit any information.</p> <p>3. Do not use industry information until areas acceptable for further consideration for leasing have been identified, then use industry information in tract delineation, ranking, and selection process.</p> <p>Is new coal leasing needed; if so, what should be the general structure of a new Federal coal management program?</p>	<p>(+) Incorporates market information into land use planning.</p> <p>(+) Incorporates industry's resource information into land use planning.</p> <p>(-) Eliminates some coal resource areas which otherwise would pass unsuitability and tradeoff screens but in which industry is not interested</p> <p>(-) Overbalances tradeoff decision in favor of coal.</p> <p>(-) Government would have to seek out resource and market information industry has already.</p> <p>(-) Mines likely to be located at sites that are not efficient for the industry.</p> <p>(-) Could bias BLM planning toward noncoal surface resources.</p> <p>(+) Industry will have strong voice in selection of tracts, but only in areas known to be acceptable for further consideration for leasing.</p> <p>(+) Incorporates market information into activity planning.</p> <p>(-) BLM multiple-use resource decision cannot be made for coal without coal "demand" estimate.</p>	<p>Paper: "Option Paper for the Secretary: Departmental Approach for the Long-Term Coal Leasing Program," September 26, 1977. Decision: Option 3; October 26, 1977.</p> <p>Secretary indicated, however, that BLM should accept industry comment at any time in process.</p>
<p>1. No Federal leasing until at least 1985.</p> <p>2. No Federal leasing, but process preference right lease applications.</p> <p>3. Emergency leasing only (bypass and maintain existing production) (Suboption would allow limited new mine leasing).</p> <p>4. Lease to satisfy industry needs.</p>	<p>(+) Low administrative burden.</p> <p>(-) Low assurance of meeting NEP goals.</p> <p>(-) Low assurance of leasing least-cost coal.</p> <p>(-) Shifts environmental impacts to non-Federal lands.</p> <p>(c)(0) Shifts coal production to East.</p> <p>(+) Moderate to low administrative burden.</p> <p>(-) Low assurance of meeting NEP goals.</p> <p>(-) Low assurance of leasing least-cost coal.</p> <p>(-) Low capability to incorporate environmental considerations.</p> <p>(c)(0) Shifts coal production to East.</p> <p>(+) Moderate to low administrative burden.</p> <p>(-) Low assurance of meeting NEP goals.</p> <p>(-) Low assurance of leasing least-cost coal.</p> <p>(-) Low capability of incorporating regional environmental considerations.</p> <p>(-) Restricts new-entrants to coal industry.</p> <p>(+) High assurance of meeting NEP goals.</p> <p>(+) High assurance of leasing least-cost coal.</p> <p>(+) Low administrative burden.</p> <p>(-) Low capability to incorporate regional environmental considerations.</p> <p>(-) Low capability to mitigate social and fiscal impacts.</p>	<p>Paper: "Need for Leasing System Choices," June 23, 1978. Decision: Option 7; June 30, 1978. (See also Sections 2-7, 2-8, and 2-9 of this statement.)</p>

- (a) The options have been edited to clarify their presentation in this Table.
- (b) Note the pros and cons have, in some cases, been reduced by deleting repetitious arguments, i.e., where an advantage of one option is a disadvantage of other options because it is lacking from them. Also in a few cases where the comments of the Assistant Secretaries developed pros or cons which were not in the original papers but that weighed significantly in the decision, these arguments have been added. Readers are requested to refer to the papers cited for a full description of issues, options, and pros and cons. Papers are available upon request to the Department of the Interior.
- (c) Neutral, neither pro nor con from a national perspective.

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
5. Let States determine level of leasing directly through final veto.	(-) High administrative burden. (-) No assurance of meeting national priorities without central decision maker. (-) Secretary abandoning resource responsibilities. (0) High weight on mitigating local fiscal and social impacts.	
6. Lease to meet or exceed DOE production projections.	(+) High assurance of meeting NEP goals. (+) High assurance of leasing least-cost coal. (-) Moderate ability to mitigate social, fiscal, and environmental impacts. (-) Secretary abandoning resource responsibilities.	
7. Merge DOE production projections with inputs from States, local governments, industry, and interest groups to derive DOI regional production targets.	(+) High assurance of meeting national NEP goals. (+) High assurance of leasing least-cost coal. (+) High ability to mitigate social, fiscal, and environmental impacts. (-) Moderate-to-high administrative burden.	
What sale system should the Department adopt?		
1. Lease using single tract system (require separate sales for each tract).	(+) Easiest system to administer. (+) Allows for more definitive activity planning and sale schedule proposal. (+) Greater assurance of leasing where the Department feels is best. (-) Where little competition involved, puts heavy reliance on fair market value.	Paper: "Bidding Systems," June 23, 1978. Decision: Option 3; June 30, 1978.
2. Lease using intertract system (offer several tracts in a sale, lease only those with highest bid).	(+) Maximizes revenue by maximizing competition. (+) Offering large number of tracts lessens chance of appearing to favor any one party. (+) Greater opportunity for operation of industry preference. (-) More complex to administer. (-) Proposal action difficult to define for EIS. (-) Time, money, and manpower spent on tracts not sold, but these tracts can be used in later sales.	
3. Retain discretion to use either.	(+) Allows Department to gain experience with intertract concept. (+) Gives Department means to deal with various ownership patterns. (-) Department expends effort on developing two systems rather than one, complicates program.	
Should the current deferred bonus bidding system be used exclusively or should the Department experiment with other bonus bidding systems?		
1. Continue to use deferred bonus bidding system exclusively.	(+) Administratively simple. (+) Department has experience with system. (+) Risk factor in coal not as great as in OCS. (-) Might increase front end cost burden on coal companies. (-) Deferred bonus bidding may favor large over small companies.	Paper: "Bidding Systems," June 23, 1978. Decision: Option 2; June 30, 1978.
2. Experiment with alternative bidding systems and adopt those successful.	(+) Allows greater flexibility to meet varying situations. (-) Complicates administration of program.	
What form of final pre-sale State consultation should the system adopt (choices in addition to consultation occurring during planning and tract selection)?		
1. Only consult if tract is for surface mining in National Forest (statutory requirement).	(+) Easiest option to administer. (+) Follows letter of statute. (-) Would reduce consultation from current practice. (-) Artificially stresses National Forest coal.	Paper: "State and Local Government Participation," June 23, 1978. Decision: Option 2; June 30, 1978.
2. Consult on all tracts with an optional response period of from 30 to 60 days except for mandatory period on National Forest.	(+) Allows Secretary to respond when serious concern seems likely, but otherwise to proceed with timely sale. (+) Assures States will be allowed to present case to Secretary. (-) Greater administrative burden than #1. (-) Introduces delay into sales.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND/DATE COMMENTS
3. Extend statutory privilege to all lands.	(+) Maximizes state opportunity for participation. (-) Potential to introduce delay into system great (up to 8 months) and would have delayed even if States did not desire it.	
What should be the role and scope of the site specific analysis and the resulting stipulations?		
1. Analysis and stipulations based only on planning data should be included at the time of lease sale. Rely on mining plan to develop specific site stipulations.	(+) Applicant bears data cost. (+) May shorten time to go from land use plan to sale. (-) Increases risk to bidder of non-operable or expensive lease. (-) Could result in FIS being needed for mining plan.	Paper: "Setting of Environmental Conditions for Lease Terms," June 23, 1978. Decision: Option 2 June 30, 1978.
2. Develop sufficient information prior to leasing to answer basic environmental and economic questions (i.e., reasonable certainty that tract will meet SMCRA standards) but may proceed with less information than needed for mining plan. Stipulations are to be detailed, must require compliance with SMCRA, and be subject to change in response to new information from mining plan.	(+) Reduces risk of offering for sale deficient tract. (+) Clarifies pre-lease and mining plan analysis objectives. (-) Imposes additional cost and time on system. (-) May inhibit mining plan manager from adding needed additional stipulations.	
3. All lease stipulations should be formulated at the time of lease sale and detailed data must be available then.	(+) Gives industry greatest assurance that mining will be permitted under lease without new costs to meet later stipulations. (-) Very high data costs before certain tract will be sold. (-) Lengthens time for tract selection significantly.	
When should mandatory public hearings occur in system?		
1. Prior to adoption of land use plan, and/or		
2. After draft regional environmental assessment, and/or	Generally, the Department should maximize public comment opportunity. However, effectiveness of public hearings decreases as more hearings are held. Probability of comments causing change in material presented declines the further into the process the hearing is held.	Paper: "Public Participation," June 23, 1978. Decision: Options 1 and 2; June 30, 1978.
3. After final environmental impact analysis and before sale.		
How should the Department define and apply the phrase "Maximum Economic Recovery" (MER)?		
1. Calculate maximum economic recovery on a seam-by-seam basis (If seam is profitable it must be mined).	(+) Bonus bids will be higher than for Option 2 since less cost to operate. (+) Lower susceptibility to coal price decrease. (-) May "lose" marginal seams from supply. (-) More acreage leased. (-) Increases potential for double opening of same ground.	Paper: "Maximum Economic Recovery," June 23, 1978. Decision: Option 2; June 30, 1978.
2. Calculate maximum economic recovery on basis of all seams in land (all seams which collectively are profitable must be mined) with consideration for social and environmental costs.	(+) Less acreage disturbed. (+) Greater conservation of resource. (-) Potential for subsidence is high because of deep mining that may be required. (-) Increased economic cost to society. (-) High administrative burden.	
3. Use engineering practice to guide determination.	(+) Uses expertise of mining supervisor. (+) Pre-lease analysis is simplified. (-) Could result in lower production rates. (-) Could result in litigation. (-) Judgments could be of varying quality and probably not consistent.	
Should stipulations on the end uses for the coal be part of the process?		
1. Use stipulations to restrict technology or location of final use permitted for coal mined from Federal tracts.	(+) Gives program additional means to mitigate social/fiscal/environmental impacts. (-) Legal basis has not been adequately researched. (-) Greater administrative burden.	Paper: "Leasing for Limited End Uses," June 23, 1978. Decision: Option 3; June 30, 1978.
2. Use end-use stipulations only in support of special opportunity bidding programs.	(+) Strengthens statutorily required program without extending into new areas of regulation. (-) Legal basis has not been adequately researched.	
3. Defer for further study.	(+) Allows for more study needed of this question. (-) Poses some risk to programmatic FIS.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
What policy posture should the Department take toward public body leasing?		
1. Keep "public body" leasing program to the minimum size possible while still satisfying the Federal Coal Leasing Amendments Act of 1976.	(+) Least program cost and complexity. (+) The larger operations of private coal operators are easier to adopt to environmentally desirable operations. (-) Lose benefits of "public body" participation.	Paper: "Public Body Leasing," June 23, 1978. Decision: Option 2; June 30, 1978.
2. Treat "public body" leasing as a major component of the system and encourage "public body" participation, but do not modify fair market value requirements or provide other financial incentives.	(+) Presents competition for private coal operators. (+) Can be accomplished without any major adjustments to system timing. (-) BLM would have to maintain two separate leasing systems and continually audit public body coal use.	
3. Treat "public body" leasing as a major component of the coal leasing program and encourage use.	(+) Ensures relatively low cost coal to "public bodies." (-) Risks appearance of favoring "public body" leasing without adequate mandate. (-) Higher administrative costs.	
How should the Department manage preference right lease applications (PRLAs)?		
1. Continue current practice (no review for consistency with land use plans or unsuitability criteria).	(+) Least administrative burden. (+) Avoids possible controversy. (-) Could result in mining in areas that would be unsuitable under new coal management program. (-) Postpones desirability question to mining plan stage. (-) Does not satisfy President's request to scrutinize PRLAs.	Paper: "Management of Preference Right Lease Applications," June 23, 1978. Decision: Option 3; June 30, 1978.
2. Reprocess PRLAs in light of land use planning and unsuitability criteria <u>prior</u> to engaging in commercial quantities determination.	(+) Would develop better understanding of how much coal would be forthcoming from PRLAs. (+) Meets President's request. (+) Assures consistent review. (-) Faces probable legal challenge by present holders of applications. (-) Adds to administrative complexity of coal management program. (-) May study applicants that cannot make showing.	(The Secretary also indicated that the Department should proceed to identify the least harmful twenty PRLAs and proceed to process them under the <u>NRDC v. Hughes</u> agreement.)
3. Reprocess PRLAs and determine commercial quantities simultaneously. Review each application to decide whether it meets current planning and unsuitability criteria. Use appropriate tools to avoid undesirable development.	(+) Meets President's request. (+) By combining work should be less costly than under Option 2. (+) Offers increased chance of timely production. (-) Open to possible legal challenges. (-) Adds to administrative complexity of program.	
How should the Department manage non-producing existing leases?		
1. Review all non-producing leases (regardless of production plans) to decide if the leases could be operated in an environmentally acceptable manner. Use appropriate tools to avoid undesirable development.	(+) Gives the Department best estimate of how much coal might be produced and need for new leases. (-) High administrative costs. (-) May process some leases that would not be developed.	Paper: "Management of Existing Leases", June 23, 1978. Decision: Option 2; June 30, 1978. Expanded by: Paper: "Land Unsuitability Criteria", September 22, 1978. Decision: October 3, 1978.
2. The Department would await the fulfillment by the lessee of the legal obligations required to initiate mining (submission of a mining plan) before reviewing the desirability of lease development. (This does not preclude evaluation as part of the normal planning process.) The new planning requirements and unsuitability criteria would be applied to all non-producing leases. The mine plan would be reviewed in light of the unsuitability criteria to determine which, if any, apply. If any criterion applies, the specific criterion and any exception to it which the conditions permit to be applied would be identified. If a criterion does not apply and the conditions do not permit an exception, a further decision would be made on whether the land is exempt from the criterion because of the source of the authority for the criterion.	(-) Uncertain legal environment. (+) Maintains consistency with new leasing where possible. (+) Moderate administrative costs. (-) Does not resolve planning uncertainty surrounding existing leases. (-) High cost to lessee.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
How will regional targets be used in the management system?		
1. Targets enter planning process at MFP stage and serve as constraint for resource tradeoffs.	(+) Provides explicit guidance for tradeoff planning decisions. (+) Makes coal consistent with planning for other resources being managed. (-) No flexibility for regional tradeoffs. (-) Makes least use of industry information. (-) Might require more frequent cycling of land use plans. (-) Intertract sales would not be possible.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process", July 18, 1978. Decision: Option 2; July 28, 1978.
2. Targets used at point of regional tract selection.	(+) Allows maximum flexibility for intraregional tradeoff. (+) Does not require frequent recycling of land use plans. (+) Allows intertract bidding. (-) Places heavy emphasis on untried unsuitability concept. (-) Changes BLM resource decision process.	
3. Targets with safety factor multiplier enter at land use plan level and goals used at regional level.	(+) Target available for guiding land use plan decision. (+) Develops pool of possible tracts for possible use in intertract sales. (-) Could be seen as developing unneeded tracts. (-) Disaggregation of targets to planning unit level difficult.	
How should industry tract interest information be used?		
1. Used to delineate tract boundaries only after "best" areas are identified.	(+) Department could not be seen as reacting to industry. (-) Ignores opportunity to use valuable industry information. (-) May result in development of tracts that are not least cost or that are of no interest to industry.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process", July 18, 1978. Decision: Option 2; July 28, 1978. (See also decision of October 26, 1978)
2. Used to select "best" leasing tracts from areas acceptable for further consideration for leasing.	(+) Allows the party who ultimately will be mining a bigger role in identifying areas for lease.	
Should lands unsuitability criteria be adopted by Department?		
1. Criteria should be adopted by Department.	(+) Assures consistency among field units. (+) Provides local land managers a standard. (+) Provides a mechanism for assessing cumulative impacts of statutory regulation and policy. (+) Higher level of public visibility. (+) Provides greater compatibility with State programs. (-) Decreases flexibility at local level. (-) May require administrative changes and costs. (-) Rigid application might restrict tract availability.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process", July 18, 1978. Decision, Option 1; July 28, 1978. (See October 3, 1978, Decision).
2. Criteria should not be adopted so that maximum discretion is exercised at field level.	(+) No changes needed in existing planning procedure. (+) Risks of new system avoided. (-) Secretary has less assurance local land tradeoffs reflect major national preferences. (-) No consistent mechanism for use on PRLAs and existing leases.	
Should regional comparisons be based on areas or specific lease tracts?		
1. Rank by areas.	(+) Ranking process is more meaningful with larger geographic area. (+) Less open to charges of favoritism to any one company. (-) More diverse information to assess. (-) Requires all plans on same schedule. (+) Allows use of industry information.	Paper: "Intraregional Matter Affecting Design of a Coal Leasing Process", July 18, 1978. Decision: Option 3; July 28, 1978.
2. Rank by tracts.	(+) Ranking should cost less. (-) Requires all plans on same schedule. (-) Closer identification with specific coal companies.	
3. Rank by both areas and tracts "Ranking factors will include many values, including environmental".	(+) Does not require all planning to be on same schedule. (+) More flexibility to field managers. (-) Some loss in consistency of ranking.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S OPTIONS

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
Should coal leasing be restricted to areas identified in CRO/CDP maps?		
1. Require only that coal leases be issued within KRCRAs.	(+) Would make the widest area available for consideration. (-) Department might end up trying to lease tracts with inadequate knowledge of value of coal deposit.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process," July 18, 1978. Decision: Option 3; July 28, 1978.
2. Lease only in areas identified as high or medium coal development potential by the CRO/CDP maps.	(+) Ensures consistent coal data. (-) Pressure would be applied to increase CRO/CDP effort, increasing costs.	
3. Require only that coal leases be issued within KRCRAs but retain coal quality as a ranking factor and use CRO/CDP maps for information.	(+) Makes widest area available for consideration. (+) Encourages use of CRO/CDP data for consistency. (-) Possibility for inconsistency in coal data use.	
Should the Department adopt a policy of preferring either clustered or dispersed leasing patterns within a region?		
1. Adopt policy preference prior to leasing for either (a) clustered lease pattern or (b) dispersed lease pattern.	(+) Ensures Secretary that possibility for strategic arrangements of tracts will be studied. (+) Ensures Secretary regional and local "carrying capacity" will be studied. (-) Does not allow for dynamic approach and reduces state and local input. (-) Concerns mentioned in the two "pros" above can be met in ranking process and, therefore, flexibility is surrendered without gain.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process," July 18, 1978. Decision: Option 2; July 28, 1978.
2. Leave decision to local land managers, requiring only that social impacts be one of the factors considered in ranking tracts and that local land managers consider interdependence of tracts on ranking.	(+) Maximum flexibility for local land managers. (+) Maintains integrity of ranking system design and of leasing process. (-) Moves this decision from programmatic EIS to regional EIS, lowering visibility.	
Should assured access to Federal lease tracts be obtained prior to sale?		
1. Lease only those tracts with known assured access.	(+) Avoids manpower and dollar costs of new access program. (+) Fosters competition. (+) Confines access to existing corridors or corridors government has strong control over. (-) May be seen as unfair to companies interested in areas that would not qualify and to consenting surface owners. (-) Eliminates an unknown number of tracts.	Paper: "Intraregional Matters Affecting Design of a Coal Leasing Process," July 18, 1978. Decision: Option 3; July 28, 1978.
2. Adopt full-scale access acquisition program.	(+) Likely to increase the number of bidders and level of bids on certain tracts. (+) Would allow better job of planning for environmental impacts of access. (-) Would involve new program and new costs. (-) Benefits of guaranteed access are not clear yet. (-) Could add time to leasing schedule and lower number of available tracts.	
3. Status quo (access responsibility of winning bidder).	(+) No additional manpower or costs. (+) No risks of untried new program. (-) May lower competition on certain tracts. (-) May risk post-sale failure to mine where access blocked.	
4. Offer assured access on an experimental basis.	(+) Department could ascertain benefits of program without committing manpower and costs. (-) Adds to complexity of program management.	
5. Attempt to "acquire" access together with surface owner consent, otherwise proceed as for Option 1.	(+) Gives lessees assurance of access. (+) Would integrate with split-estate program, taking advantage of conceptual similarities. (-) ELM may not be party selected to directly acquire surface owner consents. (-) Adds complexity to very delicate split-estate program.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
What approach should the Department adopt for an ongoing environmental analysis strategy?		
1. Prepare a national coal sale EIS covering all proposed sales to occur in a specified period of time in all production regions. The one EIS would cover all potential site-specific, regional, interregional, and national impacts.	(+) No update of programmatic needed. (+) All possible levels of impact in one document. (-) Administratively complex. (-) Dilutes capability to make specific comments. (-) If statement challenged entire program may be delayed.	Paper: "Environmental Analysis Strategy," August 31, 1978. Decision: Option 2; September 15, 1978.
2. A regional, site-specific EIS would be prepared on a four year schedule of lease sales in each region delineated in the programmatic EIS. Each regional EIS would include analysis of both the site-specific and intraregional cumulative impacts of the proposed leasing actions. Lease sales schedule would be reconsidered two years later when the next biennial process of establishing new regional production targets is completed. If, in any region, substantial differences are found in tract ranking (because of the preparation of additional land use plans or the updating of existing plans or because of changes in environmental, social, or economic conditions) or the relevant new regional production target which requires a change in the tracts proposed for sale, a supplement to the regional statement would be prepared. National and interregional impacts of the Federal coal management program would be analyzed in the programmatic EIS. The document would be updated when conditions change sufficiently to require new analysis of those impacts. (Suboption: Include all pending mining plan approval actions in regional statement.)	(+) Better compatibility with existing BLM organization. (+) Takes maximum advantage of existing analysis in programmatic. (+) Regional schedules could be adopted to regional situations. (-) Several statements would have to be prepared instead of one. (-) Possible controversy over when a programmatic update is needed.	
Should the Secretary condition his decision to proceed with leasing based on existence of split estate (surface/minerals under different ownership) in lease area?		
1. Do not lease where "surface owner" restrictions of Section 714 of SMCRRA apply.	(+) Avoids adverse social impact. (+) Implementation easy. (0) Shifts location of environmental damage away from Northern Great Plains. (-) By restricting supply of coal may raise cost to consumer.	Paper: "Coal Leasing: Surface Owner Consent," June 23, 1978. Decision: Option 4; June 30, 1978.
2. Same as Option 1, but encourage coal companies to purchase split estates.	(Same as Option 1, moderated somewhat) (-) Outright purchase costs may raise price of coal. (-) Dislocates surface owner permanently.	Modified by: Paper: "Split Estate Leasing Implementation," August 31, 1978. Decision: Option 4; September 15, 1978.
3. Attempt to lease all coal regardless of ownership but decline to lease where compensation payments exceed a standard amount.	(+) Minimizes cost to consumer. (-) Difficult implementation. (-) Subject to legal challenges.	
4. Attempt to lease all coal regardless of surface ownership with passive compensation safeguards through fair market value computation.	(+) Tend to minimize cost to consumer. (+) Implementation straightforward. (+) Should not inhibit development of split estate coal significantly. (-) Fair market value not easily determined.	(Subject to Solicitor's review.) (Suboption considered would have reduced cost allowed for split estates compensation in fair market value computation to zero.)
5. Lease all coal regardless of surface ownership and compensation.	(+) Minimal cost for implementation. (-) Possibly raises cost to consumer. (-) Loss of government income.	
Who should acquire surface owner consents and when?		
1. Industry would acquire consent or options during the development of their expressions of interest and file them with these expressions. Options would be transferable. Terms of the consent options would have to be presented to the Department with the expressions of interest in an area.	(+) Direct government involvement not required. (+) Leasing can proceed without risk of surface owner consent refusal. (-) High cost burden on industry, not all consents will result in leasing. (-) Surface owner faces possible long period of uncertainty regarding use of his land. (-) Surface owner does not have full information available to assist him in making decision.	Paper: "Split Estate Leasing Implementation," August 31, 1978. Decision: Option 2; September 15, 1978.
2. Industry would have the responsibility in the Federal coal management program of acquiring surface owner consent. Consents would have to be filed with the BLM prior to the sale announcement. The consents would be required to be transferable. If no filing of consent is made on a tract prior to the sale announcement, the tract would be removed from the sale schedule (and, if necessary, another tract substituted for it), unless the BLM determines that the tract should nevertheless be offered for lease sale. Should such a determination be made, the successful bidder on that tract in the sale would be given a period of time after the sale to obtain consent. NOTE: Under Secretary added option to have consent acquired after sale.	(+) Direct Government involvement not required. (+) Gives industry most time to negotiate. (+) Allows industry to judge better degree of risk involved in financing consents because of information developed from tract analysis is available. (-) Government bears risk of going through site-specific analysis without surface owner consent. (-) Puts cost burden on industry.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
3. Industry would acquire consents after lease sale announcement but consents must be filed before the actual sale. Consents would be transferable to a third party and consent payments would be contingent on successful sale. Date of actual sale may be held up pending receipt of indication of consent on tract to be offered.	(+) Direct government involvement not required. (+) Industry will be aware of terms of sale before paying for consent. (-) Short time allowed for negotiation. (-) Continues uncertainty regarding consent for tract to last moment, putting all government at risk. (-) Puts cost burden on industry.	
4. Company would acquire consent after it is successful in lease sale; the consent would have to be filed before lease is executed.	(+) Direct government involvement not required. (+) Avoids question of who should negotiate. (+) Avoids unneeded consents. (+) Surface owner has full information. (+) Minimizes direct administrative expenses. (-) Puts previous expenditures of time and funds in preparing tract in jeopardy. (-) Surface owner in very strong bargaining position. (-) Uncertainty of acquiring consents may reduce competitiveness of sale. (-) Puts cost burden on industry. (-) Government would not know if split-estate tracts would be mined until after costs of sale.	
5. At the time the surface owner is consulted by BLM in the planning process, he or she would be offered the opportunity to agree to a written consent to surface mining or to agree to an option for such a consent. The Department would bind the eventual successful bidder to the terms of the consent, including all payments at the time of lease execution. If consent were not forthcoming the area would be dropped from further consideration until the next round of planning--5 to 10 years later. Alternatively, if consent were not forthcoming, but the surface owner indicated a preference for allowing surface mining, the area would remain in the leasing process and a second opportunity would be given the surface owner by BLM prior to offering the tract for lease sale.	(+) Possible reduction in costs of program. (+) Leasing program could proceed without uncertainty caused by consent power. (-) May be seen as unfair to split estate owners. (-) Makes consultation more complex. (-) Relatively lower chance of successfully getting consent. (-) Government bears cost of consent.	
6. BLM would begin to directly seek surface owner consents at the time of tract ranking and would continue to acquire consents through completion of site-specific analyses. Payment would be by the successful bidder at time of lease execution. Third party consents would be negotiated.	Same as Option 2 except government bears cost of consent acquisition. (+) Government could keep program more in phase with tract ranking process. (-) May require new authority to pay for consent.	
7. BLM would negotiate surface owner consents following completion of site-specific analyses and before tracts are offered for sale.	Same as Option 3 except government bears cost of consent acquisition. (+) Surface owner gets maximum information. (-) BLM would be in difficult negotiating position because of costs sunk in tract analysis and selection.	
What should the Department's policy be toward pre-existing consents?		
1. Offer tracts which are covered by nontransferable consents in intertract sales only.	(+) Meets Secretary's policy regarding transferability of consents. (-) Requires BLM to institute new program.	Paper: "Split Estate Leasing Implementation," August 31, 1978. Decision: Option 3; September 15, 1978.
2. Decline to lease tracts with pre-existing consents that are not transferable.	(+) Minimizes administrative cost of pre-existing consent process. (-) Subject to possible legal challenge.	
3. (Combination of 1 and 2) Tracts which are selected for lease sale and which include areas covered by pre-existing consents would be offered for sale if the consents are determined to be transferable. If any pre-existing consent is determined to be nontransferable the tract would not be offered for sale unless it is included in an intertract sale.	(+) Processes greatest number of consents. (-) Greatest administrative burden.	
Should the Department require compensation be paid to companies for consents they acquire?		
1. A surface owner consent agreement would be considered transferable only if it provides that (1) the payment for the consent is to be made by the successful bidder after the lease sale in which the lease for the tract to which the consent applies is sold or (2) after the lease sale, the successful bidder is permitted to reimburse the company which first obtained the consent for the purchase price of the consent.	(+) Low administrative costs. (+) Encourages companies to acquire consents by ensuring they would not be bound to pay cost of consent on the tracts they do not obtain. (-) Complicates negotiations between coal companies and surface owners.	Paper: "Split Estate Leasing Implementation," August 31, 1978. Decision: Option 1; September 15, 1978.
2. Foster the sharing of risk of losing consent costs by encouraging the development of industrial groups for the purpose of acquiring consent options.	(+) Reasonably low administrative costs. (-) May be seen as anti-competitive by encouraging grouping of would-be lessees in future sales.	
3. Take the position that loss of consent costs is a normal business risk in which the government should not be involved.	(+) No administrative costs. (-) Would discourage industry from acquiring consent unless they had competitive edge. (-) One company might end up paying for another's consent acquisition.	

TABLE 3-3
(Continued)

POLICY OPTIONS - SECRETARY'S PREFERENCE

ISSUES AND OPTIONS	PROS AND CONS	PAPER AND DATE/COMMENTS
Where will the unsuitability criteria be applied? How will the unsuitability criteria be applied? (NOTE: Paper presented application procedure that appears in Section 3.1 of this statement.)		
1. Accept 2. Defer 3. Reject 4. Modify	No pro/con analysis developed.	Paper: "Land Unsuitability Criteria," September 22, 1978. Decision: Option 1; October 3, 1978.
What specific criteria should the Secretary adopt?		
Criteria in the following areas were considered:		
1. Federal land systems. 2. Right-of-way and easements. 3. Buffer zones along rights-of-way and adjacent to communities and buildings. 4. Wilderness study areas. 5. Scenic areas. 6. Land used for scientific study. 7. Historic lands and sites. 8. Natural areas. 9. Federally-listed endangered species. 10. State listed endangered species. 11. Bald and golden eagle nests. 12. Bald and golden eagle roost and concentration areas. 13. Falcon cliff nesting sites. 14. Migratory birds. 15. State resident fish and wildlife. 16. Wetlands. 17. Floodplains. 18. Municipal watersheds. 19. National resources. 20. Alluvial valley floors. 21. Prime farm lands. 22. Reclaimability. 23. State lands unsuitable. 24. State-proposed criteria.	No pro/con analysis developed. (Development and analysis of the criteria are described in the final report of Task Force 2 available from the Department.)	Paper: "Land Unsuitability Criteria," September 22, 1978. Decision: Accept 19 criteria; October 3, 1978. Reject criteria on rare vegetation, accept all others. Additionally, Assistant Secretary Energy and Minerals was asked to recommend criteria for: 1. Alluvial valley floors 2. Reclaimability 3. Prime farm land Paper: "Proposed Additional Unsuitability Criteria," October 30, 1978. Decision: Accept Criteria 20 through 24; November 2, 1978.

improving coal development patterns for a given amount of coal production. This analysis, together with the overriding consideration that the Department requires a coal management system in place to respond to immediate needs, is the basis for the Secretary's preference for a Federal coal management program which merges DOE production goals with advice from state and local governments, the coal industry, and other interest groups to determine leasing levels. Critical to this Departmental preference is the program component of continual reassessment of future regional coal needs in order to modify leasing activity in response to changes in projected demand for future coal.

The coal management review also surfaced several issues concerning how various data would be incorporated into land use and activity planning decisions.

3.3.2.3 Use of Coal Production Targets. The issue was raised as to when in the program coal production targets should be used. The Secretary preferred that production targets be used at the point of regional tract selection and not be part of the general land use planning process. This preference is consistent with the previously described Departmental decision to first determine areas acceptable for further consideration for coal leasing and then seek industry expressions of leasing interest. The option also ensures that the planning system would first produce the best resource management decisions without the constraint of meeting pre-selected production targets.

3.3.2.4 Tract Delineation. Another issue raised was how would industry expressions of leasing interest be used in defining tract boundaries within areas acceptable for further consideration for leasing. This issue must be considered in light of the Secretary's previously described preference for seeking industry expressions of interest after acceptable areas have been defined. The preferred option is to seek industry interest immediately after the land use planning process defines areas acceptable for further consideration for coal leasing. Expressions of interest and information from both industry and other sources would be used to delineate tracts. Tracts would then be ranked and selected for coal lease sales.

3.3.3 Issues Concerning Management of Existing Leases and Preference Right Lease Applications

Tables 2-18, 2-19, and 2-20 indicate the current extent of Federal leases and preference right lease applications (PRLAs). The Federal coal policy review included consideration of the Department's role in the possible future development of currently non-producing leases as well as consideration of processing of outstanding PRLAs.

In the case of non-producing leases, the Department's preference is to apply the unsuitability criteria to the area of the leasehold at the time that the lessee submits a mining plan. If all or part of the leasehold is found unsuitable for mining, appropriate action (e.g. purchase, exchange, environmental stipulations, etc) would be taken to prevent mining. The application of the unsuitability criteria to existing leases depends on a variety of factors, including the statutory

authority for each criterion and the nature of the lessee's commitments and rights.¹

Outstanding PRLAs similarly would be examined for acceptability for mining using the unsuitability criteria; however, this process would not be dependent upon applicant initiative. All PRLAs would be processed through the land management agencies' planning systems. PRLAs, or portions thereof, entitled to a lease which are found unsuitable would be purchased, exchanged, or conditioned to protect environmental, socio-economic, or other values.

3.3.4 Split Estate Leasing Issues-Surface Owner Consent

The background for the split estate leasing issues is given in section 3.2.4.1. Initial questions considered by the Department were how section 714 of SM CRA might affect the general location of areas which may be considered for new leasing and should the Department be concerned over compensation for granting section 714 surface owner consents.

The Secretary expressed his preference to consider leasing in all areas and to monitor compensation by including surface owner compensation at a preset level in the fair market value computation. A ranking factor would be used which reflects a preference to lease coal first under Federal surface and second under private surface (other factors being nearly equal).

A second set of section 714 questions considered were when during the tract delineation, ranking, and selection process surface owner consents would be acquired, and who should acquire consents--the Federal government or industry. These two questions are set out in a matrix of possible program choices in Table 3-4. In studying these two issues, the following factors were considered:

- The later in the process surface owner consent is obtained, the less the administrative costs of obtaining consent no matter who acquires it. Administrative costs are somewhat mitigated by tying them to points in the leasing process where contact must be made for reasons other than surface owner consent: that is, at the time of surface owner consultation and at the time of gathering industry expressions of interest.
- The later in the process, the more information the surface owner has available and the stronger his bargaining position.
- The later in the process, the greater the risk to the government of loss of the time and money spent on evaluating and analyzing coal leasing tracts.
- The less direct involvement that BLM has, the lower the agency's administrative costs and vulnerability to charges of government interference.
- The less the BLM involvement, the lower may be the government's ability to monitor compensation for the purposes of complying with the Mineral Leasing Act of 1920.

The Department prefers a combination of options. Industry would have the responsibility of acquiring surface owner consent before a lease could be executed. Consents would have to be filed with the BLM prior to the sale

development provisions of the FCLAA. The Department of Energy now has the authority to promulgate diligent development regulations.

¹Under existing regulations, issued leases that are not in production by 1986 would be subject to cancellation for failure to comply with the diligent

TABLE 3-4

MATRIX OF POSSIBLE PROGRAM CHOICES
FOR SECTION 714 SURFACE OWNER CONSENTS

WHEN?	WHO?	
	INDUSTRY	BLM
1. Contemporaneous with surface owner consultation (planning)	Not feasible	Yes, passively for those willing to volunteer
2. Adjunct to obtaining industry expression of interest	Yes, as part of interest package	Not applicable
3. Beginning with tract ranking and continuing through tract analysis	Feasible	Feasible
4. Prior to offering for sale	Feasible	Feasible
5. After sale, but before executing lease	Feasible	Not feasible

announcement. Each consent would be required to be transferable to any third party who successfully bids in a lease sale on a tract which contains the area to which the consent applies.

If no filing of consent is made on a tract prior to the sale announcement, the tract would be removed from the sale schedule (and, if necessary, another tract substituted for it), unless the Secretary determines that the tract should nevertheless be offered for lease sale. Should such a determination be made, the successful bidder on that tract in the sale would be given a period of time after the sale to obtain consent.

A third set of issues raised in the consideration of section 714 concerned compensation standards, managing pre-existing consents, and reimbursement of negotiating costs. As previously discussed, the Secretary has indicated that he prefers to influence the levels of compensation offered for consent through fair market value.

Pre-existing consents (i.e., those in effect prior to SMCRA) were validated under section 714 regardless of terms. Many of these consents were acquired under state laws. (Note, the Department will act to make all such consents publicly available.)

The Department prefers that tracts which are selected for lease sale and which include areas covered by pre-existing consents be offered for sale if the consents are determined to be transferable. If the pre-existing consent is determined to be nontransferable, the tract would not be offered for sale unless it is included in an intertract sale.

Requiring industry to negotiate consents not only transfers the negotiation costs to industry from the government, but also imposes on one company (the holder of the consent) the risk of bearing the surface owner consent costs for the lease of another (the successful bidder). The effect of this policy would be to discourage coal companies from negotiating consents except in cases where they felt they might have a strong competitive edge. The Department would resolve this problem by requiring that a pre-sale, company-acquired surface owner consent agreement be transferable and that an agreement be considered transferable only if it provides that the successful bidder either pay the consent cost directly to the surface owner or reimburse the company which first obtained the consent for the purchase price of the consent.

3.3.5 Post-Programmatic Environmental Analysis Strategy

The National Environmental Policy Act of 1969 requires each Federal agency proposing a major action which might significantly affect the quality of the human environment to prepare a statement of the environmental impacts of that action and its reasonable alternatives. The Department, in formulating the preferred coal management program, considered which key leasing decision points could represent major Federal actions within the meaning of the Act.

The preferred option is to maintain two separate levels of environmental impact analysis, one to consider interregional and national impacts and one to consider site-specific and cumulative intraregional impacts. The first level of analysis would be contained in this programmatic environmental

impact statement, updated when necessary, and the second level of analysis would be made in environmental impact statements for each region covering four-year sales periods and discussing the tract delineation, ranking, and selection process. These environmental analyses procedures in the preferred program are discussed in greater detail in section 3.1.1.7.

3.3.6 Maximum Economic Recovery

In section 3 of the Federal Coal Leasing Amendments Act of 1976 (FCLAA), the Congress introduced the concept of Maximum Economic Recovery (MER). The Congress has indicated that MER is of considerable importance and should be treated in a consistent and formal manner. The statute requires MER to be considered at two stages: (1) lease issuance and (2) mine plan approval. Specifically, section 3 of FCLAA, requires that: "Prior to issuance of a lease, the Secretary shall evaluate and compare the effects of recovering coal by deep mining, by surface mining, and by any other method to determine which method or methods or sequence of methods achieves the maximum economic recovery of the coal within the proposed leasing tract. This evaluation and comparison by the Secretary shall be in writing but shall not prohibit the issuance of a lease; however, no mining operating plan shall be approved which is not found to achieve the maximum economic recovery of the coal within the tract."

The issue forwarded for the Secretary's expression of preference was what definition of MER should be adopted. Five different definitions were considered; the Secretary prefers that MER be calculated in a way that all coal seams which are collectively profitable must be mined, taking into consideration social and environmental costs. For any scale of development (annual production rate), this definition would tend to minimize the area disturbed from surface mining; deeper seams would be substituted for the broadening of areas of operation.

3.3.7 End-Use Considerations

Another question considered by the Secretary was whether the Department should condition new coal leases with stipulations which specify how, where, or by whom coal would be consumed. The goals of such restrictions would be to:

- More actively control the location and extent of environmental degradation.
- Promote the entry of economically and socially disadvantaged groups to the coal industry.
- Allow more active integration of Federal actions with State and local government planning, and otherwise control socioeconomic impacts.
- Encourage new energy technologies.

Coal leases have not in the past limited how lessees could dispose of mined coal. A lessee can sell the coal for a mine-mouth power plant, ship coal short or long distances, or use the coal for gasification. Specifying the end-use of coal from new leases could give the Department greater control over the environmental and economic effects of mining and could be used to encourage new technologies. There is, however, a very real possibility it could infringe upon other agencies' responsibilities, such as state regulation of power plant siting

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and EPA Clean Air Act regulations. In addition, the Department's legal authority to regulate end-use is unclear.

Options for resolution of this issue ranged from not adopting end-use stipulations (except as mandated in the FCLAA for public bodies) to an active policy of conditioning leases to meet all the goals specified above. The Secretary preferred not to adopt end-use stipulations pending a Solicitor's opinion on the Department's authority for such action. The Solicitor's opinion is being developed.

3.3.8 Public Body Leasing

Section 2 of the FCLAA directs the Department to set aside and offer for sale a reasonable number of coal lease tracts to nonprofit consumer-owned utilities, principally municipal utilities and rural electric cooperatives, and Federal agencies. This special class of lessees (referred to as public bodies) must use the coal to produce energy for their own use or for the use of their owners or customers according to a definite plan.

The statute leaves leeway for Departmental interpretation of the number of tracts which might be offered at special sales for public bodies and of the frequency of such sales. Public body leasing could play a substantial role in any new Federal coal management program as public bodies currently provide slightly over 10 percent of the Nation's electrical generating capacity.

Accordingly, options for public body leasing ranged from a program element of minimal size to a component of major proportions. The Secretary prefers to adopt a major program which actively responds to the energy needs of public bodies; however, leases to public bodies would not include any special financial incentives such as reduced royalties or lower acceptable bids at lease sales.

3.3.9 Detail of Lease Stipulations

Assuming the Federal land management agency has identified a tract for coal leasing, a question arises as to the degree of specificity of environmental protection stipulations attached to the lease. The question is basically one of what level of data should the government assemble prior to leasing a tract and how much data development should be left to the individual coal companies to accomplish during mining plan preparation.

It is the Secretary's preference that the land management agency develop sufficient information prior to leasing to answer basic environmental and economic questions (e.g., that development of the tract could proceed in compliance with the provisions of SMCRA) with reasonable certainty. However, lease stipulations would not be as detailed as those that would be attached to a mining permit. Lease stipulations for environmental protection would be subject to modification to address problems identified in the government's review of mining plans.

3.3.10 Other Issues

Successful implementation of the planning process depends to a large extent on participation of non-Federal organizations and private individuals. The Secretary's preferences on issues concerning public hearings and consultation between state governors and the Department

reaffirm the Department's overall position that the preferred coal management program be continually responsive to the interests of affected organizations and individuals. Furthermore, while the Secretary does not prefer that states determine leasing levels, states would nevertheless be provided consultation opportunities at key points in the preferred program. The states' knowledge of, and concerns for, socio-economic factors would be critical in evaluating and disaggregating the regional production targets which would guide leasing levels and influence the tract ranking process.

With respect to bidding procedures, the Department prefers to retain discretion to use either single tract or intertract systems. The intertract system would likely introduce an added degree of competition in the lease sale. The Secretary deferred selecting bonus, royalty, or other bidding methods.

Finally comes the rather large option area of unsuitability criteria. The Secretary first considered whether the land management agencies' field offices preparing land use plans should be given complete local flexibility in the determination of specific lands unsuitability criteria. The Secretary first expressed the preference that specific criteria and exceptions be adopted by the Department and then be applied at the field office level. Then, he subsequently selected specific unsuitability criteria and chose the manner in which they would be applied to the different types of leases under the coal management program. The Secretary prefers that criteria be applied to all types of coal leases, though in applying the criteria the Department will, of course, recognize valid existing rights. The specific criteria are presented in Table 3-1. The criteria represent the principal means of protecting certain key environmental features against destruction because of coal development.

3.4 PLANNED AND ON-GOING STUDIES

During the formulation of the preferred program, the Department identified several aspects of the program for additional studies. Generally, these studies clarify procedural details and will not need Secretarial action. These studies are summarized below. The Department specifically requests public comments on the subjects covered by these studies.

The Department intends to study how the land management agency will determine who are qualified surface owners for consultation and at what point in the land use planning process surface owners will be consulted. The objective of this study is to develop procedures which allow cost-efficient identification of qualified surface owners and careful consideration of their views.

The preferred program and several alternatives involve a series of resource allocation decisions which move from large regions to smaller planning areas and finally to lease tracts. The accuracy of these resource trade-off decisions is largely a function of the precision of data employed in the decisionmaking. Therefore, a major study that the Department has underway is an assessment of the potential for efficiencies in coal program data gathering, recognizing the various degrees of accuracy required at each decision point. This study is being conducted by an interagency task force and may be used as a model for addressing data issues for

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other resources throughout the Department. Questions being examined are:

- What are the information requirements (including level of data) called for by the Department's existing and evolving coal program responsibilities?
- What is the status of existing resource inventories and what are the plans for future updating and new data collection efforts?
- What significant opportunities exist for improving the coordination and efficiency of data gathering and use?
- What steps have already been taken to address these issues (e.g., interagency memoranda of understanding agreements) and what additional potential solutions merit further considerations?

The Department will conduct a study, in close cooperation with the western coal states, to specify the procedural details of tract ranking and selection, and sale scheduling. The objective of this study of the tract ranking, selection, and scheduling process is to fully develop standardized procedures for judging the relative attractiveness of potential lease tracts and at the same time for providing opportunities for recognition of varying degrees of importance of resource values within the several regions. The environmental impacts of choosing one factor over another are described in this statement in Chapter 5.

The steps leading to acceptance or rejection of preference right lease applications (PRLAs) and the methods for incorporating the production potential of the accepted PRLAs into the tract ranking, selection, and scheduling process need to be specified in greater detail before application in the field, and specification of these steps is the objective of another study.

The preferred program and several other alternatives have components to allow for emergency situations (bypass or maintenance of production) and to allow special leasing opportunities for non-profit public utilities (public bodies), and for small businesses. The procedural and administrative details of these components will be studied and specified.

Once tracts are scheduled for a competitive sale, under the preferred program and several other alternatives the economic terms of proposed leases must be specified. The Department intends to review and refine the details of determining maximum economic recovery and fair market value. Additionally, the Solicitor is preparing an opinion on the meaning of the term "fair market value" in the law in connection with the split-estate leasing process.

Another economic aspect requiring clarification is the procedure to be followed under the intertract sale method, especially the events on the day of such a sale. Items such as qualification of bidders, use of sealed or oral bidding, time allowed between bids, and when to close the sale must be clarified.

The Secretary has requested a study of the costs of guaranteeing access to tracts and whether they outweigh the

benefits which might accrue to the government in higher bids. The Department is also sponsoring a related, but independent, study on consolidating ownership over logical mining units prior to sale by forming agreements with States or private owners.

The objective of the above studies of the economic aspects of new leasing is to foster a competitive market place and to ensure a fair return to the public for the use of their resources.

Section 510(b)(5) of SMCRA provides that in certain cases, where coal mining of non-Federal coal would interrupt or damage farming or water supplies in alluvial valley floors, the Secretary may acquire interests in such lands in exchange for interests in lands not so affected. If the affected lands are held by the permit applicant under a Federal lease then the Secretary can exchange that lease for one of similar value. The Department will study the best way of effecting such exchanges.

As discussed above, the Secretary considered whether to adopt a policy of controlling in special cases how and where coal mined from Federal leases would be used. The Department's current position in the preferred program analyzed in this statement is not to do so; however, this is an interim policy pending not only the final version of this statement, but also the Solicitor's study of the authority under which an affirmative program of end-use control might be adopted.

All of the above studies are scheduled for completion in time to be included in the program considerations of the Secretary, which will come during the month following the issuance of the final version of this statement. These studies are needed to develop procedural details of the program and its alternatives for many of the major elements of the program. These major elements are all described and analyzed in this statement. Most studies should be available by April 1979, with the remainder reaching completion over that summer. If new issues are identified through these procedural studies, these issues will be developed and analyzed and appropriate steps will be taken to comply with the National Environmental Policy Act of 1969 with respect to these issues.

3.5 REFERENCES

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2. U.S. Department of the Interior, 1978. Land Unsuitability Criteria. September 12, 1978. Washington, D.C.
3. U.S. Department of the Interior, Office of the Solicitor, 1977. Section 714, Washington, D.C.

CHAPTER 4

DESCRIPTION OF REGIONAL ENVIRONMENTS

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CHAPTER 4

DESCRIPTION OF REGIONAL ENVIRONMENTS

This chapter contains descriptive discussions of the environments of twelve coal regions specified in Chapter 1 (See Figure 1-1). The components of each region are discussed cumulatively due to their physical continuity and their similar environments. Each regional description is subdivided into a discussion of the environment and a discussion of the environment and man. The sections on the environment contain descriptive information on the regions' topography, geology, resources, climate, air quality, water quality, and biota. The sections on the environment and man contain descriptive information on history, resource development, economics, infrastructure, and demography. The descriptions are limited to only those environmental features which are pertinent to the environmental impact analyses described in Chapter 5.

4.1 THE APPALACHIAN COAL REGION

The Appalachian Coal Region encompasses 111,637 square miles in nine eastern states and contains an estimated 103 billion tons of coal reserves. For purposes of discussion, it has been divided into three regions: the Northern Appalachian, Central Appalachian, and Southern Appalachian Coal Regions.

The Northern Appalachian Coal Region covers 53,120 square miles in 94 counties of Pennsylvania, Ohio, West Virginia, and Maryland. The Central Appalachian Coal Region covers 35,292 square miles in 70 counties of West Virginia, Kentucky, Tennessee, and Virginia. The Southern Appalachian Coal Region covers 23,225 square miles in 39 counties of Tennessee, Georgia, and Alabama.

4.1.1 The Environment

The dominant topographical feature of the Region, the Appalachian Mountain Range, reaches elevations of up to 5,000 feet in the Central Region. Elevations in the Northern and Southern Regions are much lower, although large changes in relief do exist. The steep-sided plateaus of sandstone bedrock on the eastern side of the range give way to broad open folds dipping gently to the west.

This difference in the topography of the eastern and western sides of the Appalachians reflects the two different physiographic provinces involved. The Valley and Ridge Province to the east consists of rocks that have been greatly disturbed by faulting and folding. The Appalachian Plateaus to the west have not been subject to such severe disturbance and the gently folded rocks are nearly flat. Unique or significant geologic features, such as caverns and karst areas are numerous.

Sandstones, shales, limestones, conglomerates, and beds of coal are characteristic of the three Appalachian Coal Regions. Coal-bearing rocks are of Pennsylvanian age and

include the Monongahela, Conemaugh, Allegheny, and Pottsville Formations.

The rank of coal in the Appalachian Coal Region varies with physiographic provinces, reflecting the differing amounts of deformation the rocks received. The coal in the Appalachian Plateaus (on the western edge) is high-volatile bituminous, with some coal being as high in grade as anthracite.

In general, the Appalachian Coal Region has moderate to hot, humid summers and moderate to cold, humid winters with an average annual precipitation of 40-50 inches. Growing seasons (periods of frost-free temperatures) vary from 120 to 210 days. The mean annual relative humidity is about 70 percent. The most distinctive climatic difference between the subregions is the monthly distribution of precipitation.

The Northern Appalachian Coal Region has coldest temperatures; the average annual temperatures are 50-58°F, with minimum January temperatures of 20-30°F and maximum July temperatures of over 70°F. Summer is the season of maximum precipitation. Light wind speeds are common, with an average of 9.5 miles per hour (mph) at ridge level and 6 mph in the valleys.

The Central Appalachian Coal Region has a more moderate climate with mild, damp winters and hot, humid summers. The mean annual temperatures are 56°F-58°F. The annual precipitation is 45-50 inches, though some sheltered valleys receive less than 40 inches and higher elevations in some areas of Tennessee receive over 55 inches. The Central Appalachian Coal Region has two seasons of maximum rainfall, spring and summer; fall brings the least precipitation. The winds are similar to those in the Northern Appalachian Coal Region: 8-9 mph on the ridges, 50-60 percent less in the valleys.

The Southern Appalachian Coal Region has mild, wet winters and hot, humid summers. The annual mean temperature reaches 60-65°F, while precipitation averages 53-55 inches annually. The maximum precipitation is received in late winter and early spring, as in the Central Coal Region. Fall has the least rainfall.

In none of the regions do extremes in meteorological conditions occur often enough to restrict habitation, land use, or physical resources. Seasonal flooding along river, stream, and creek banks, occasional hurricanes in the southern areas and more rarely in the northern areas, severe winter storms ("northeasters" in the Northern Coal Region), and infrequent droughts or tornadoes may have temporary local adverse effects on land use.

Land use, however, can affect local climates. Large quantities of heat and moisture or disruption of surface features can alter temperatures and moisture conditions, and thus affect local growing seasons. Major surface disturbance can also lead to loss of ground cover (which provides shade

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and soil stability), which could result in changes in relative humidity, soil temperature, soil moisture, and susceptibility to flash flooding. Solid particulates in the air can weaken intensity of solar insulation, while sulfur dioxide in the air can lead to acid rain which will corrode limestone, marble, etc.

Various meteorological parameters, such as speed, persistence, and direction of winds, can affect the significance of the negative impacts of land uses on air quality. Frequency and persistence of atmospheric inversions can be considered a limiting factor to pollution-creating land uses in the Appalachian Coal Region. In the Northern Coal Region, surface-based inversions occur 35-45 percent of the time in winter and up to 60-70 percent of summer mornings. Poor dispersion also occurs frequently in late summer and fall in the other regions. This creates a high potential for stagnation of poor quality air throughout the region, particularly in the summer.

This combination of particular types of land use and climatic conditions had obvious effects on air quality in some parts of the Appalachian Coal Region. In heavily industrialized and mined areas in Pennsylvania, Ohio, and West Virginia, such as the Steubenville-Weirton-Wheeling Interstate Air Quality Control Region (AQCR), the national primary ambient air quality standards for sulfur dioxide and suspended particulate matter are not being attained. In most other counties and AQCRs in the Appalachian Coal Region, however, the air quality is good. In Maryland, Virginia, Kentucky, Tennessee, Georgia, and Alabama, measurements of sulfur dioxide and suspended particulate matter are generally better than the national standards.

Unlike most of the other regions to be discussed in this statement, the Appalachian Coal Region has an abundant supply of surface water. Droughts are uncommon and, in fact, many areas are flood prone. The Ohio River and its tributaries are major streams in the Northern Appalachian Coal Region, and the average annual stream flow from the Upper Ohio River Basin (as measured at Sewickley, Pennsylvania) is 23.3 million acre-feet. In the Central Coal Region, the Big Sandy and Kanawha Rivers provide the upper Ohio and upper Tennessee River system with the most abundant surface water flow of the three regions - 49.7 million acre-feet.

Use of surface water is constant throughout the year in all the regions, with industry and municipal entities being the dominant consumers. Annually, 1.3 million acre-feet is used in the Northern Coal Region, 1.5 million in the Central Coal Region, and only 23,000 in the Southern Coal Region. Agricultural use of surface water is nil.

Topography has an important influence on both quantity of runoff and quality of surface water. Runoff is higher in the steep areas of the Valley and Ridge Province to the east than in the more gently sloping Appalachian Plateaus in the west. Likewise, sediment load and total dissolved solid content are greater in the eastern areas than in the western ones. Average sediment load ranges from 250-280 milligrams per liter in the western areas, and can jump to 2500 mg/liter in high runoff areas on the eastern rim. Likewise, total dissolved solids can vary from 100-350 mg/liter in the west to over 1200 mg/liter in small areas of the east. Surface water quality is also significantly influenced by land uses. Many of the nation's acid-mine drainage pollution problems are in the Northern Appalachian Coal Region. Other industrial and municipal

wastes also plague surface water quality throughout the Region.

Ground water in the Appalachian Coal Region is most prevalent in some carbonate rocks, sandstones, and shoestring deposits of sand and gravel occupying flood plains along the principal streams. Well yields range from only a few gallons per minute to 500 gal/min., depending on the permeability of the rock. Groundwater quality is generally poor in the Appalachian Coal Region, with hardness and local excesses of iron, manganese, and hydrogen sulfide being the primary problems. Mining, industrial, and municipal wastes locally adversely affect ground water quality.

Due to an abundance of surface water in the Appalachian Coal Region, groundwater does not play as significant a role in the survival of man, plants, and animals as it does in much of the West. Groundwater use is relatively low with a high of 190,000 acre-feet per year in the Central Coal Region and a low of 11,500 acre-feet in the Southern Coal Region.

Geology, topography, and climate are important factors in determining soil type. Generally, the soils in the Appalachian Coal Region are a mix with weakly differentiated horizons that exhibit the alteration of various parent materials. Soils are low in organic matter with subsurface horizons of clay accumulations. Most of the soils in the Coal Region are well-drained with low natural fertility. Moderate to severe erosion hazard is common.

There are two major native vegetation communities in the Appalachian Coal Region, the Eastern Deciduous Forest (primarily in the Northern and Central Coal Regions) and the Southeastern Mixed Forest (Southern Coal Region). The wide variety of forest and understory vegetation, good interspersing of terrestrial and aquatic habitat types, and the abundance of water resources give the region the cover, water, space, and forage needed to accommodate a multitude of wildlife species. Over 300 species of fish, 96 species of reptiles and amphibians, 110 species of birds, and 200 species of mammals, as well as innumerable invertebrates, inhabit the region on either a permanent or seasonal basis. It is impossible to identify all the plant and animal species in the subregions so only some of the major or characteristic species will be noted.

In the Northern and Central Appalachian Coal Regions (from Ohio and Pennsylvania south to West Virginia and Kentucky, and along lower slopes of mountains extending into the Southern Coal Regions), beech and maple are the predominant species. Closely associated oaks, sweetgum, tulip, hornbeam, basswood, wild cherry, dogwood, hedge maple, hawthorne, and alder are also present. From Tennessee south into the Southern Coal Region, the character of the Eastern Deciduous Forest changes somewhat, with oak becoming the dominant species. Tulip, sweetgum, and shagbark hickory are also common. The chestnut, which was one of the dominant species in early history, has almost been completely eliminated from the region by disease. Typical animal species in these areas of the deciduous forest include such game and furbearing species as the whitetail deer, black bear, wild turkey, eastern cottontail, raccoon, opossum, gray squirrel, and gray and red fox, and such birds as woodpeckers, thrushes, warblers, vireos, and owls.

The Southern Coal Region contains some immature sandy soils, or lowlying marsh soil, overlain by pine forests. Lobolly, shortleaf, pitch, Virginia, longleaf, and slash pines are

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the most widespread varieties. Typical animals in these forests include such game species as black bear, whitetail deer, and ruffed grouse, and such birds as nuthatches, chickadees, woodpeckers, and warblers.

Aquatic and riparian vegetation throughout the Appalachian Coal Region includes such species as loosestrife, arrow-arum, pondweed, water lilies, plaintains, and cattails. The rivers, streams, and lakes in the region support many aquatic insects and mollusks, as well as game fish such as bass, trout, crappie, bluegill, pike, pickerel, muskellunge, and catfish, and non-game fish such as carp, shad, shiners, chubs, and sculpins. These same water sources and the riparian habitat near them accommodate turtles, lizards, muskrat, otter, beaver, and many species of snakes, frogs, and salamanders.

Agricultural crops are varied and numerous in the region. The animal species which prefer agricultural land habitat and can live in relatively close association with man are whitetail deer, robin, crows, mourning dove, bobwhite, red fox, raccoon, hawks, and owls.

Currently, there are 13 species of animals within the Appalachian Coal Region that are listed as endangered under the Endangered Species Act of 1973; the bald eagle, peregrine falcon, Bachman's warbler, red-cockaded woodpecker, eastern cougar, gray bat, Indiana bat, watercress darter, and five species of mussels. Although there are no federally listed threatened or endangered plants within the region, there are a large number proposed for listing. These are presently under consideration by the U.S. Fish and Wildlife Service.

There are numerous local variations (due to topography, soil, and climate) in vegetation and wildlife that will require site-specific assessments to identify exact distributions of vegetative species. In the coal basin region of Alabama, the uplands plantlife is dominated by Virginia, shortleaf, longleaf, and loblolly pines; turkey and red oak; sweetgum; and winged elm, because they are tolerant of shallow, dry, nutrient-poor soils. Lower slopes, however are occupied by larger, deciduous hardwoods and a great variety of shrubs that require more water. The valley bottoms with deep soils are lush with an even wider variety of vegetation including agricultural crops. The wildlife species present vary according to the habitat preferences defined earlier.

Land uses have reduced vegetative quantity and diversity in the past few hundred years, but of the various coal regions, the Appalachian Coal Region maintains the highest diversity. Natural primary productivity is moderate to high (8.9 tons per acre per year in forests to 17.8 tons per acre per year in floodplain areas). Forest cover can return naturally within 80 to 100 years after severe disturbance. This natural productivity, combined with excellent climatic conditions, gives the Appalachian Coal Region higher potential for reclamation than the western coal areas. Currently, coal mining rehabilitation can rapidly establish a ground cover of grasses and legumes and restore suitable fish and wildlife habitat for many species. Research has not been oriented towards recreating original composition and diversity of native forests, and therefore it is not yet possible to evaluate whether current reclamation will be able to restore land to original or better productivity for tree growth in this region. Reforestation, however, is possible within 50 years of the cessation of mining operations.

4.1.2 The Environment and Man

The history of mankind in the Appalachian Coal Region can be divided into the Paleo-Indian period (prior to 8000 BC), the Eastern Archaic tradition (8000 to 1200 BC), the Woodland tradition (1200 BC to 900 AD), the Mississippian period (900 AD-1650 AD), and the proto-historic and historic cultures.

The Paleo-Indian occupation is reflected in the Meadowcroft Rock Shelter site in Washington County, Pennsylvania, dated at 14,200 BC. These Indians were nomadic hunters who used hunting implements, pebble-choppers, hand axes, and scrapers.

The loss of traditional food sources at the end of the Pleistocene is thought to have led to the development of the Archaic tradition. Hunting continued, but fishing and plant gathering became more common. Populations increased and life became more sedentary. Earliest pottery in the southeastern U.S. is thought to have been made in Georgia in approximately 2000 BC, and pottery is the most distinctive feature of this tradition.

During the Woodland tradition, pottery manufacturers flourished, villages grew in size, and social organization became more formal; burial mounds were a distinctive feature of this tradition. The Mississippian culture, with large, permanent villages, riverine agriculture, and ceremonial mounds, was the next major influence, most evident in the Southern Coal Region. During the proto-historic period, riverine agriculture, hunting, and fishing continued to provide subsistence. The dominant aboriginal groups included the Chickasaws, Choctaws, and Creeks.

Approximately 40 archaeological sites throughout the Appalachian Coal Region, remnants of prehistoric and proto-historic cultures, are listed on the National Register of Historic Places. The potential remains for discovery of more values during future site-specific surveys, particularly in sparsely inhabited areas near lakes and streams.

The beginning of the historic period is commonly defined by the arrival of Hernando deSoto (who explored parts of the Appalachian and Gulf of Mexico areas in the 1500's), but the major influx of Europeans did not start until the early 1700's. The first white settlements were built in the early 1800's as the British and French competed for land. The settlers were primarily farmers (corn, hogs, cattle, cotton, and tobacco) with secondary occupations as blacksmiths, cobblers, and millers. Slavery was important in the Southern Coal Region and parts of the Central Coal Region. Railroads, wagon trains, and steamboats helped the settlers penetrate into the frontier and displace the native Americans.

As early as the 1830's, coal mining had begun to rival the cotton industry in some areas. By 1860, factories (producing lumber, carriages, cotton and wool products, and machinery) and coal mines were active throughout the Appalachian Coal Region.

The Civil War sparked mineral activity (smelting and casting furnaces) throughout the Appalachian Coal Region. During the War, many industries, particularly in the Central and Southern Coal Regions, were damaged. Cotton production gave way to new industries such as iron and steel manufacturing in the late 1800's. As these industries grew, so did the need for coal.

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There was steady economic progress after the turn of the century. Coal production was booming in the 1920's. Other industries that began to grow included steam, natural gas, oil, and electricity.

Over 600 historic sites (houses, covered bridges, iron furnaces, railroad buildings, battlefields, land-mark oil wells, and other structures), reminiscent of the Appalachian Region's varied and colorful history, are listed on the National Register of Historic Places. This comprises one third of all the National Register sites in the coal regions.

There is wide variance in the socio-economic characteristics of the three regions. The Appalachian Coal Region, as a whole, is very distinct from the Western regions. Tables 4-1, 4-2, and 4-3 show population, employment, and other socio-economic characteristics of the three regions.

The Northern Appalachian Coal Region is the most densely populated with a population of over 8,019,000 in 1975 and a density of over 150 people per square mile. The Central and Southern Coal Regions both have populations over 2,000,000, but the density in the Central Coal Region is slightly less than 60 people per square mile, while in the Southern Coal Region it is almost 100 people per square mile. All the regions experienced high out-migration rates during the 1960's. In the 1970's, out-migration in the Northern Coal Region slowed considerably and the other two regions gained population.

In the region as a whole, manufacturing and wholesale and retail trade have replaced agriculture and mining, important occupations in earlier history, as the major employment sectors. In 1975, these sectors employed from 36 to 53 percent of the populations of these regions.

In 1975, coal mining employment ranged from only 1 percent in the Southern Coal Region to 12 percent in the Central Coal Region. Development of other minerals employed less than 4 percent of the regions' populations, while agriculture employed 4 to 10 percent. In small localized areas throughout the region, minerals development or agriculture may provide the dominant employment opportunity.

Land uses are varied. Most farms are small (averaging less than 160 acres each), and the major crops include cotton, soybeans, corn, wheat, sorghum grain, hay, and fruit. Some of the best farm land is along the Ohio River, as it was in prehistoric and historic times. Beef cattle, sheep, and hogs remain important products of the agricultural sector.

As mentioned previously, there is active mining throughout the region. Federal leasable minerals include oil, gas, and coal. The greatest potential for development of federally owned oil, gas, and coal is found in the Black Warrior Basin in the Southern Coal Region. Saleable minerals in the Appalachian Coal Region include sand, gravel, shale, and clay. The most important hardrock minerals are iron, zinc, and copper. Most of the federally owned coal reserves are located in the numerous national forests within the Appalachian Coal Region's boundaries. The only Appalachian land under the jurisdiction of the Bureau of Land Management is 3,066 acres in Alabama.

In the Appalachian Coal Region, coal is transported by waterway, railroad, and truck. There are no coal slurry lines. The Appalachian coal is closer to demand centers, and transportation costs are lower than those involved in development of western coal. Some problems in transport of

coal in the region exist, however. Inadequate lock systems and congestion in the waterway system (which includes the Mississippi, Ohio, Greer, Warrior, and other rivers) are causing bottleneck delays in some areas. Abandonment and deterioration of railway lines is making transport by rail more difficult in areas like West Virginia. The use of trucks is growing as coal production increases. This results in increased noise and air pollution, road congestion, and safety hazards. Some counties have resorted to levying taxes to correct environmental damage caused by coal trucks.

Other land uses include urban and suburban development, communication sites, powerlines, gas pipelines, sand and gravel pits, and sanitary landfills. Access to most federally owned coal is afforded by county or state owned and maintained, all-weather, paved or gravel roads of varying quality.

Recreation is an important land use to be considered. The Appalachian Coal Region has over 138 state parks, 10 state forests, and 10 other state owned recreational facilities, covering over 511,000 acres and attracting over 56 million visitors a year. Camping, hunting (deer, turkey, and small game are most popular), fishing (bass, blue gill, trout, and catfish primarily), boating, spelunking, hiking, rockhounding, and skiing are just a few of the opportunities available.

The region contains many rivers presently included in the Wild and Scenic Rivers System (e.g., 45 miles of the Obed River in Tennessee, 33 miles of Little Beaver River in Ohio). Others are being considered for inclusion (e.g., parts of Pine Creek in Pennsylvania; Sipsey Fork River in Alabama). There are also four wilderness areas, totaling nearly 48,000 acres, in the Central and Southern Coal Regions. Three trails (North Country, Kittanning, and Potomac Heritage) are being considered for inclusion in the National System of Trails.

About 23 billion tons of coal had been extracted from the beginning of mining in the region until 1965. One-third of this was from the Pittsburgh coal bed, making it one of the most valuable beds in the U.S. The number of coal beds in the region varies from 10 in Pennsylvania to 62 in West Virginia.

4.2 EASTERN INTERIOR COAL REGION

The Eastern Interior Coal Region is located within the Central Lowland and Interior Low Plateaus of the United States. Most of this 59,000 square mile region is in Illinois, with smaller portions in Indiana, Kentucky, and Iowa, respectively. The region encompasses 127 counties, 70 of which are in Illinois.

4.2.1 The Environment

The Eastern Interior Coal Region is a combination of smooth and irregular plains within the Mississippi and Ohio River watersheds. The Illinois, Indiana, and Iowa portions of the plains are smooth almost to Kentucky, due to the influence of the Illinois glacier. The remainder of the region is unglaciated and its topography is therefore hilly. In this portion of the region, local relief varies from 100 to 500 feet with steep bluffs occurring along many of the rivers. The elevation of the entire region does not exceed 1,000 feet above sea level.

The region's geological formations are primarily sedimentary rocks from the Upper Paleozoic Era of

TABLE 4-1

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
NORTHERN APPALACHIAN REGION^(a)

1975 Total Population ^a	8,019,531			
Total Area (square miles) ^a	53,120			
Population per square mile (1975)	151.0			
Per Capita Personal Income (1975)	\$5,035			
Per Capita Personal Income as a Percent of National Average (1975)	99			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	17,757	1	99,503	0-1
Other Agriculture	74,931	3	279,375	1
Metal Mining	2,981	0-1	880	0-1
Coal Mining	53,274	2	896,422	3
Oil and Gas	12,982	0-1	154,875	0-1
Other Mining	7,377	0-1	52,430	0-1
Construction	116,867	4	1,760,699	6
All Manufacturing	934,034	33	12,125,795	40
Transportation, Communication, and Public Utilities	129,432	5	2,311,325	8
Wholesale and Retail Trade	547,078	20	4,433,231	14
Finance, Insurance, and Real Estate	97,113	3	988,438	3
Other Services	378,951	14	3,927,846	13
Federal Govt.	46,496	2	685,095	2
State and Local Govt.	376,057	13	2,868,185	9
TOTAL	2,795,330		30,584,099	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

TABLE 4-2

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
CENTRAL APPALACHIAN REGION (a)

1975 Total Population ^a	2,069,980			
Total Area (square miles) ^a	35,292			
Population per square mile (1975)	58.65			
Per Capita Personal Income (1975)	\$4,009			
Per Capita Personal Income as a Percent of National Average (1975)	79			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	12,750	2	24,726	0-1
Other Agriculture	44,855	8	93,889	2
Metal Mining	-	-	-	-
Coal Mining	71,304	12	1,262,813	21
Oil and Gas	3,310	1	31,195	0-1
Other Mining	2,765	0-1	9,008	0-1
Construction	22,804	4	409,618	7
All Manufacturing	112,632	19	1,250,226	20
Transportation, Communication, and Public Utilities	19,959	3	494,300	8
Wholesale and Retail Trade	101,901	17	837,525	14
Finance, Insurance, and Real Estate	17,936	3	174,169	3
Other Services	66,858	11	735,106	12
Federal Govt.	13,886	2	206,263	3
State and Local Govt.	92,803	16	622,461	10
TOTAL	583,763		6,151,299	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

TABLE 4-3

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
SOUTHERN APPALACHIAN REGION (a)

1975 Total Population ^a	2,289,614			
Total Area (square miles) ^a	23,225			
Population per square mile (1975)	98.6			
Per Capita Personal Income (1975)	\$4,551			
Per Capita Personal Income as a Percent of National Average (1975)	90			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	8,713	1	38,269	0-1
Other Agriculture	46,610	6	132,660	1
Metal Mining	-	-	-	-
Coal Mining	6,299	1	124,581	1
Oil and Gas	-	-	-	-
Other Mining	3,972	0-1	12,401	0-1
Construction	47,836	6	592,107	7
All Manufacturing	260,722	30	2,656,267	30
Transportation, Communication, and Public Utilities	29,965	3	602,998	10
Wholesale and Retail Trade	165,260	19	1,445,685	16
Finance, Insurance, and Real Estate	39,359	5	433,204	5
Other Services	93,809	11	1,232,646	14
Federal Govt.	48,520	6	799,721	9
State and Local Govt.	106,450	12	782,012	9
TOTAL	861,545		8,852,551	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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approximately 300,000,000 years ago. Rock strata are dominated by sandstones, limestones, conglomerates, and shales. Various paleontological formations are associated with these strata, as well as the region's coal deposits.

The principal coal bearing formations are the Lower Pennsylvania, Pottsville, and Allegheny formations. The coal deposits are composed almost entirely of low-volatile bituminous. A three county area of southern Illinois, however, contains high-volatile bituminous deposits. In addition to coal, the mineral resources of the region include petroleum, clay, crushed stone, gravel, and sand.

To a great extent, soils in the northern half of the region have derived from glacial drift and windblown deposits. Soils from two to five feet deep predominate in this portion of the region. Top soil is generally black, friable, and high in organic content. The unglaciated southern portion of the region has soils with a thinner layer of top soil. Soils in this area are derived from windblown deposits overlaying glacial till. These soils have a gray-brown surface layer that is medium to highly basic. This surface soil often overlies an impermeable clay pan that produces poor internal drainage. Soils of the entire region are fertile. Those in the northern portion are the more productive.

A temperate climate prevails throughout the region. Annual mean temperatures range from 48°F in the north to 60°F in the south. Seasonal extremes range from -20°F to 110°F.

Precipitation volumes also increase from north to south; the northern areas receive about 30 inches a year, while the southern areas receive 40 inches per year. The region has snowfall, although it is generally less than 10 inches annually. Storms are most frequent in the winter and spring months. Summer storms generally track from the north and are weaker. Autumns are often dry with little storm activity until November. Although short dry periods do occur, the region is not vulnerable to sustained droughts.

The region is subjected to a variety of winds from Canada, the Great Plains, and the Gulf Coast. Wind speeds average approximately 10 miles per hour, which is above the nation's average. The lack of topographic barriers permits continual ventilation and air quality is good. There are generally less than 20 days a year during which the region is subjected to high levels of air pollution. These episodes are generally short-lived. Certain urban centers do create some localized air quality problems. These problems are restricted to Evansville, Indiana, where high particulate and moderate sulfur dioxide levels occur; Terre Haute, Indiana, where high particulate levels occur; Springfield, Illinois, where moderate particulate levels occur; and Peoria, Illinois, where moderate particulate levels occur.

With its precipitation patterns and two major waterways, the Eastern Interior Coal Region generally has plentiful supplies of water. A dendritic drainage pattern is formed by the Mississippi and Ohio Rivers, their major tributaries such as the Illinois and Wabash Rivers, and the smaller tributaries of these. During heavy rains and spring thaws, these rivers are prone to damaging floods.

Water quality varies throughout the region. For most uses, it is generally satisfactory or can be treated. Agricultural runoff can cause localized problems with bacterial contaminants, nitrogenous pollutants, and suspended solids.

Additionally, various industrial pollutants are found in the region's scattered urban centers.

It is estimated that 42.3 million acre-feet of fresh to slightly saline groundwater is in storage in the region, and some towns and cities have had difficulty obtaining wells yielding good water at reasonable costs. Over most of the region, however, fresh groundwater, at least in small to medium quantities, is not difficult to develop. Some local overpumping has resulted, since only about 4.1 million acre-feet of fresh groundwater is recharged to the system each year. Some municipalities have found it less expensive and more satisfactory to discontinue their poor groundwater sources and develop treated surface waters. Over most of the region, the depth to saline groundwater is less than 500 feet.

The above-described environmental aspects have created an ecotone-type ecology in the region. This means that the region is situated in the transition zone between the Eastern deciduous forest and the Great Plains grasslands. An oak-hickory forest dominates the natural vegetation of the Kentucky, Indiana, and southern Illinois portion of the region. The remaining portion is dominated by farmland and an oak savannah. Intensive agricultural practices occur in the region, so much of the natural vegetation has been removed. Only about 15 percent of the region is now forested.

Where natural forests exist, dominant tree species include fir, white and swamp oaks, hickory, ash, poplar, and sweet gum. Associated ground cover includes shrubs (such as mountain laurel, rhododendron, dogwood, wisteria, sumac, buckthorn, alder and hawthorn), numerous forbs, and grasses (such as winged pigweed, bishopcap, love grass, panic grass, and morning glory). Net primary productivity for forested areas is about 8.9 tons per acre per year.

Relict prairie areas exist in limited portions of the oak savannahs that have not been disrupted by agriculture. They are vegetated by mixed grasses, legumes, and other herbaceous species. Typical species are bluestem, switchgrass, and Indian grass (representative of tall grass prairie); little bluestem, needlegrass, and western wheat-grass (representative of mid-grass prairie); and buffalo grass, blue grama, and side-oats grama (representative of short grass prairie). There is a general tendency for the short grasses, more typical of western prairies, to push eastward onto the heavier soils of this region, and the tall grasses (typically eastern) to push westward onto the lighter soils. Net primary productivity of the remaining prairie in the region is about 6 tons per acre.

Typical vegetation of the wetlands and bottom areas includes spike rush, sedges, milkweed, water primrose, cattails, pondweeds, and lizardtails. These wet areas are highly productive and are valuable habitat to waterfowl using the Mississippi flyway.

The forests and prairies of the region serve as habitat for a wide variety of other wildlife species. Due to extensive farming, most wildlife within the region is compatible with man's activities. Some even depend on the farmer's fields for food and cover. Typical forest mammals include whitetail deer, eastern cottontail, gray squirrel, gray fox, and raccoon. Species typical of the prairie areas and edge habitat between forest and prairie include whitetail deer, woodchuck, red fox, and coyote. Small mammals, such as mice, shrews, and bats are numerous in both prairie and forest areas. Furbearers,

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such as mink, beaver, and muskrat, occur along waterways and in marshy habitats.

Major upland game birds found in the region include ring-necked pheasant, ruffed grouse, mourning dove, bobwhite, and turkey. Wetlands and waterways provide habitat for waterfowl using the Mississippi flyway, such as bluewinged and greenwinged teal, pintails, wood ducks, lesser scaup, black ducks, mallards, and lesser snow and Canada geese. Among the principal non-game birds are redtailed hawk, turkey vulture, great horned owl, green heron, chimney swift, cardinal, indigo bunting, crow, bluejay, brown thrasher.

Among the 15 species of game fish in the region, largemouth bass is the most popular. Other gamefish of local importance include bluegills, crappie, northern pike, catfish, yellow perch, white bass, and yellow bass.

Reptiles and amphibians found within the region include box turtles, soft-shelled turtles, snapping turtles, copperhead snakes, king snakes, cricket frogs, bull frogs, and a variety of lizards and salamanders.

Although most species have adapted to man, a few have not. Their habitats have diminished with agricultural advancement to the point where populations are very restricted and are threatened or in danger of extinction. Federally listed endangered species of wildlife within the region include the Indiana brown bat, bald eagle, tuberculata-blossom pearly mussel, Sampson's pearly mussel, and peregrine falcon. There are no federally listed endangered plants within the region's boundaries, but numerous plant species are presently under consideration by the U.S. Fish and Wildlife Service. These may eventually receive endangered status. The plants in the relict prairies are not endangered, as they are common in other prairies in the west.

The ecosystems within the Eastern Interior Coal Region are capable of recovery after human disturbances. With proper soil conditions, natural succession can return a grassland to a near original state within a decade. Forest lands require much longer to return to a stage similar to virgin timber. Natural succession, however, can return a cleared forest to an immature forest in less than 50 years, given proper conditions. With adequate management, the lands of this region could be readily reclaimed after coal mining operations.

4.2.2 The Environment and Man

The agricultural opportunities of the Eastern Interior Coal Region have historically been its major attraction for human beings. Timber and other natural resources have also been attractive but to a lesser degree. Original Indian populations were primarily village farmers. Tribes of Illinois, Miami, and Shawnee Indians produced maize and grains from the fertile soil. White men did not arrive until 1672, when two French explorers, Joliet and Marquette, led an expedition up the Mississippi and Illinois Rivers. Their journey initiated the education of the European colonists to the region's abundant agricultural opportunities. Eventually, settlers were drawn westward from the deciduous forests of the original 13 colonies to the agricultural advantages of the prairie fringe. The acquisition of the Northwest Territory by the United States in 1787 provided for this colonial expansion. In 1820 settlement was limited to the Ohio Valley, but shortly

thereafter settlements were found scattered throughout the entire region.

In 1836 a blacksmith's apprentice named John Deere was drawn to Grand Detour, Illinois, from Vermont. In 1837 he built the world's first steel moldboard plow. His invention became famous as "the plow that broke the plains." Thereafter farming became the primary regional activity and most of the land was cleared. Agriculture is still the primary land use over the entire region and is a significant contribution to the area's economic base. Most farmers grow corn, soybeans, grains, and hay for export or livestock feed. Individual farms vary in size up to 500 acres.

The timber production of the southern portion of the region has added to the region's economy. Oil is another natural resource that was found in moderate abundance in the region. It also contributes to the area's economic base.

Twentieth century industrial development adds greatly to the region's economy, but is essentially limited to urban centers. The major cities that support most of the industry are Peoria, Springfield, and Decatur, Illinois; Burlington, Iowa; Evansville, Indiana; and Owensboro, Kentucky. Coal production has played an important role in the region's industrial development; together with oil, it provides most of the energy supply. Manufacturing is the major contributor to employment, involving 26 percent of the total workforce. Table 4-4 provides additional economic data, illustrating the relative importance of specific sectors of the economy.

Surface transportation via water and rail was instrumental in urbanization. Water carrier service is available on the Mississippi, Ohio, and Illinois Rivers. Major railways serving the region include the Chessie System, Norfolk and Western, Illinois Central Gulf, Louisville and Nashville, Southern, and ConRail. In addition to these modes, a modern highway network is used for commercial and private transportation. The primary highways used for bulk commodity transportation are the interstate highways. The region is traversed by Interstate Highways 24, 64, 70, 74, 55, and 57. Oil and gas pipelines are also located in the region. Coal slurry pipelines are not present.

Historic agricultural development and recent community development have been instrumental in creating a large population growth in the Eastern Interior Coal Region. Presently, there are over 5 million inhabitants within the region. The 1975 population density was approximately 85 persons per square mile. The rural sector of the region is fairly stable, while the urbanized centers are experiencing mild growth. The area has never been exposed to any major boom town phenomena. Cultural development within the region is highly varied. Indian artifacts from cultures dating to 2000 B.C. have been discovered in Greene County, Illinois. Remnants of the Wabash and Erie Canals of the mid 1800's still remain. Historical sites relating to Abraham Lincoln's past are found in numerous locations. Over 200 individual historic sites within the region are identified for preservation by the National Register of Historic Places.

The widespread post-colonial settlement in the region has left no surface land ownership under the jurisdiction of the Bureau of Land Management. The only Federal lands within this region are Mammoth Cave National Park, which is under the jurisdiction of the National Park Service; the Hoosier National Forest, which is under the jurisdiction of the U.S.

TABLE 4-4

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
EASTERN INTERIOR REGION (a)

1975 Total Population ^a	5,191,721			
Total Area (square miles) ^a	65,153			
Population per square mile (1975)	79.7			
Per Capita Personal Income (1975)	\$5,316			
Per Capita Personal Income as a Percent of National Average (1975)	105			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	51,897	3	344,185	2
Other Agriculture	148,825	8	1,659,599	8
Metal Mining	-	-	-	-
Coal Mining	25,870	1	300,128	2
Oil and Gas	4,500	0-1	100,193	0-1
Other Mining	9,579	0-1	63,118	0-1
Construction	70,692	4	1,124,798	6
All Manufacturing	507,948	26	5,980,049	30
Transportation, Communication, and Public Utilities	77,306	4	1,240,601	6
Wholesale and Retail Trade	376,103	19	2,896,369	15
Finance, Insurance, and Real Estate	65,538	3	655,676	3
Other Services	239,895	12	2,165,833	11
Federal Govt.	84,849	4	1,007,967	5
State and Local Govt.	293,538	15	2,193,087	11
TOTAL	1,956,540		19,731,603	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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Forest Service; the Shelbyville and Carlyle Reservoirs, which are under the jurisdiction of the U.S. Corps of Engineers ; and the Crab Orchard, Meridosia, and Chantaugua National Wildlife Refuges, which are under the jurisdiction of the U.S. Fish and Wildlife Service.

4.3 WESTERN INTERIOR COAL REGION

The Western Interior Coal Region covers approximately 98,000 square miles of the central United States, with major portions in Missouri, Iowa, Kansas, and Oklahoma, and minor portions in southeast Nebraska and northwest Arkansas and encompasses over 100 counties.

4.3.1 The Environment

The Western Interior Coal Region contains a wide variety of topographic features, from irregular glaciated plains in the north to steep-sided ridges and mountains in the south. Elevations vary from 500 feet in the northeast portion of the region to 2,000 feet in the southern highlands. The region is situated within the Central Lowland physiographic province and has a generally flat to rolling topography. There are some eroded mountains in eastern Oklahoma and western Arkansas known as the Ouachita and Boston Mountains.

Present topography and land forms are largely a result of surface rocks. Resistant rocks, such as granite, sandstone, and limestone, generally form high ridges, hills, and mountain peaks, whereas nearby outcrops of shale and other easily eroded rocks form valleys and lowland areas.

In the past, forces within the earth have caused portions of the region to alternately sink below and rise above sea level. Large areas were often covered by shallow seas, and thick layers of sediments were deposited and subsequently lithified into shales, limestones, and sandstones. Later, these areas were uplifted and the sedimentary rocks were exposed and eroded.

The gently sloping hills of the northern portion of this region are composed of alluvium, glacial drift, and loess, underlain by Paleozoic sandstones, limestones, shales, and coal seams in horizontal or nearly horizontal beds with isolated faulting and gentle folding. The east-west trending ridges and valleys of the Ouachita province were formed during the early Paleozoic Age through extensive folding and faulting.

The coal beds of the region are Upper Carboniferous (Pennsylvanian) in age and mostly high-volatile bituminous in rank. They are generally of better quality than the coals of the west, but are also higher in sulfur content. The principal coal-bearing formations throughout most of the region are the Lower Pennsylvanian, Pottsville, and Allegheny formations. They comprise a lower series, that contains most of the coal, termed the Des Moines Group, and an upper series termed the Missouri Group.

Most of the Federal coal in the region is in the southern part, in Oklahoma. In this area and in western Arkansas as well, mountain-building forces of the Ouachita disturbance sufficiently devolatilized the coal beds to raise their rank to low-volatile bituminous and some localized semianthracite deposits. The coal is mostly of coking quality and is contained in rocks of the Hartshorne Sandstone and the McAlester Shale. The most important beds are the Lower Hartshorne, 2.5

to 6 feet thick; the Upper Hartshorne, 1.75 to 5.5 feet; and the McAlester Shale, 1.75 to 4 feet thick.

Most hard rock minerals are formed as a result of igneous activity. Ore mineral such as silver, lead, and zinc occur within the tri-state area of Arkansas-Missouri-Oklahoma. "Common variety" mineral materials, such as sand and gravel, building stone, crushed stone, and common clay, are abundant in most of the region. Building stone and crushed rock are quarried from sandstone and limestone. Sand and gravel are obtained from river alluvium, and clay is obtained from shale.

Coal is plentiful in the region, but production is principally in eastern Oklahoma. Oil and gas producing horizons occur principally in Oklahoma and Kansas in several different formations at a wide range of depths. Fossil-bearing strata occur throughout the region. The only ones of significance in the Federal coal reserves are those associated with coal seams of the Middle Pennsylvanian, Hartshorne, McAlester, Savanna, and Boggy formations.

The climate of the Western Interior Coal Region is characterized by hot summers and cold winters. Ranges in temperature and precipitation are pronounced. The area tends to be dominated by cold air from the Canadian arctic in winter and warm air from the southwest in summer. Temperatures in the southern portion average 40°F in January and 80°F in July. In the northern portion, they average 20°F in January and 70°F in July. The mean annual freeze-free days range from 150 in the north to 210 in the southwest.

Most of the area receives between 32 and 48 inches of precipitation per year. Months with the highest precipitation are March, April, May, and June, at the start of the growing season. Parts of the area receive over 4 inches per month during this time although they are also exposed to occasional short-lived droughts. Fall rains may average over 2 inches per month. Winter snows, particularly in the north, are common. The humidity averages between 60 and 70 percent most of the year, with some portions having a higher average in the fall and winter. The relatively high amounts of rainfall and seasonally warm temperatures combine to provide very favorable conditions for plant growth.

The area is generally windy. Average speeds near the ground are 11-14 mph. When precipitation has been sparse fugitive dust and dust storms are common. The winds are typically out of the west and northwest in the winter and out of the south the rest of the year. This area is subject to many tornadoes every year.

Air quality, in terms of particulate, sulfur dioxide, and nitrogen dioxide content, is good in most areas of the region. Some variation does exist, particularly in urbanized areas of the region. These variations are located in Kansas City, Missouri, where moderate particulate matter and sulfur dioxide levels occur; Omaha, Nebraska, where moderate particulate matter and sulfur dioxide occur; and Tulsa, Oklahoma, where low particulate matter and moderate nitrogen dioxide occur.

Most of this region has abundant supplies of water, including a considerable number of lakes and reservoirs. However, most industries and municipalities must treat surface water and some ground water before use. The quality of surface water ranges from low dissolved solids and high

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sediment concentrations during high flow periods to high dissolved solids and low sediment content during low flows.

Surface-water runoff averages about 7 inches over most of the region, ranging from 3 inches in the northwestern to 30 inches in the southern mountains. Where standing bodies of water exist in the region, evaporation ranges from about 36 inches in the north to 54 inches in the southwest. Devastating floods resulting from thunderstorms are not uncommon.

The quality of the surface water is generally good, especially in the east where the total dissolved solids are generally moderate. In the western part of the region, particularly in the northwestern and southwestern areas, the rivers not only carry a greater concentration of total dissolved solids but a much heavier load of suspended solids. The Des Moines, Iowa, Missouri, and Arkansas Rivers have the poorest quality water. In some streams, oil-field wastes and other industrial and municipal wastes have created serious problems.

Groundwater conditions vary widely with respect to quantity and quality. In the Iowa and northern Missouri portion of the region, well yields vary, but wells are generally less than 250 feet deep. Groundwater supplies in the unglaciated southern portion of the region can be obtained from river alluvium, shale, sandstone, limestone, and dolomite aquifers. The river alluvium generally yields moderate to large supplies of water of good quality. The shallow sandstone and limestone bedrock aquifers generally yield less than 25 gallons per minute of medium to poor quality water. In some parts of the area wells over 1,000 feet deep which penetrate the Cambrian and Ordovician carbonate aquifers underlying the coal bearing strata will yield over 500 gallons per minute of good to medium quality water. The dense slaty shale and hard sandstone that largely make up the Ouachita Mountains yield a poor supply of groundwater in that area.

The soils of the region vary considerably but are mostly sedimentary in origin. Soils range from organic rich bottomland to sandy hillside loams. The dominant soils in the northern part of the region are black organic rich soils that often have a brown clay subsoil. These soils developed from glacial till or loess and are generally quite fertile. The prevailing soil in the south is a dark red loam, made up of decomposed sandstone and limestone. The river valleys often have rich deposits of alluvium.

The Western Interior Coal Region includes a portion of the continent where the eastern deciduous forests merge with the prairies and plains of the west. Accordingly, there is a transition between the vegetative communities typical of both biomes. The deciduous forest, tall-grass prairie, and transitional zones, including the savannahs, make up the major habitat types. This mixture of habitat types within the region provides suitable food, shelter, and cover for a variety of wildlife.

The mixed oak-hickory forest association is common in the eastern portion of the region, grading to oak-hickory-pine forest in the southeastern portion. Associated understory vegetation includes dogwood, redbud, holly, sassafras, winged elm, wild grape, spicebush, sumac, and numerous native grasses and forbs. On well-shaded slopes, mosses, liverworts, and fruticose lichens form a continuous mat over the surface of the ground. Few mammalian species develop large populations in these forest associations. Whitetail deer,

raccoon, red fox, gray fox, eastern gray squirrel, fox squirrel, brush mouse, eastern woodrat, eastern cottontail, striped skunk, and opossum are typical mammals. Typical birds include those that prefer the upper canopy layers, such as vireos and warblers, and those occupying the lower canopy and the forest floor, such as thrashers, wood pewee, rufous-sided towhee, cardinal, wild turkey, and ruffed grouse.

The bottomland forest association occupies fertile bottomland soils of alluvial origin. This vegetative association is found along water bodies and stream courses. The more common species are willow, cottonwood, American elm, sycamore, and sweet gum. Boggy areas support a heavy cover of herbs and ferns. Understory vegetation consists of numerous small trees, shrubs, and lichens. As the forests diminish to the west, and the prairies become extensive, the relative amount of grassland and woodland varies greatly in different parts of the region. For the most part, grassland vegetation consists of a mixture of such dominants as big bluestem little bluestem, Indian grass, silver beard grass, and switch grass. Wildlife typical of prairie areas and agricultural lands within the region include whitetail deer, eastern cottontail, red fox, and coyote. Typical birds in these open habitats include horned lark, crow, cowbirds, grasshopper sparrow, bobwhite, mourning dove, and ring-necked pheasant. The greater prairie chicken may be found in the savannah type.

Distribution of water plants usually is not controlled in the same way as occurrence of the plants growing in adjacent terrestrial habitats. Many aquatic species rely on the various lakes, ponds, or streams throughout the region. Some are restricted to small areas or special types of lakes. Species which are common to the aquatic vegetation community of the region include water willow, cattails, spikerushes, duckweeds, waternelvet, water chinquapin, waterlilies, spatterdock, smooth water primrose, and a wide variety of submerged aquatic aggregations.

Water bodies within the region are generally highly productive and support a variety of fish including bullheads, yellow perch, bluegills, large mouth bass, crappie, shiners, and minnows. Furbearers associated with these aquatic habitats include mink, muskrat, beaver, otter, and raccoon. Typical birds include red-winged blackbird, herons, gulls, wood ducks, mallards, scaup, snow and Canada geese, and bald eagle.

Some of the amphibians and reptiles common in the region include cricket frog, bullfrog, collared lizard, sixlined race runner, box turtle, spiny soft-shelled turtle, ringnecked snake, kingsnake, gartersnake, and ground snake.

There are 10 species of animals occurring within the Western Interior Coal Region that now have protected status as endangered species: These include the red wolf, black-footed ferret, Indiana bat, gray bat, peregrine falcon, Eskimo curlew, bald eagle, red-cockaded woodpecker, Bachman's warbler, and Neosho mucket mussel. Presently, there is only one plant species in this region listed as endangered. This is the northern wild monkshood, with known distribution in Iowa. However, there are numerous other plants under consideration for designation as endangered or threatened. These may be given protection by the U.S. Fish and Wildlife Service.

The above-described ecosystems within the Western Interior Coal Region's boundaries are capable of natural

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reoccurrence after human disturbance. Prairie grasses can reoccur through a natural succession process within a few years of disturbance. Oak-hickory forests, however, require a much longer period to regenerate, although they too can naturally reoccur. These ecosystems would be reclaimable following coal mining operations.

4.3.2 The Environment and Man

Evidence has been found that man existed in the Western Interior Coal Region more than ten thousand years ago. Artifacts reveal that wandering tribes of hunters and gatherers were the first inhabitants of the region. Gradually, some of the tribes became sedentary and agricultural communities developed. The region is rich in archeological sites dating from many periods. Over 60 of these sites are included in the National Register of Historic Places.

Recorded history began in 1541 when Francisco Vasquez de Coronado crossed the region in his search of the fabled city of Quivera. In the seventeenth and eighteenth centuries, French trappers and hunters wandered down the Missouri River and settled on its tributaries. The Missouri River was the principal travel route for the explorers of the early 1700's, and became the standard route for the traders travelling between St. Louis and the Mandan Indian villages in the northern Great Plains during the 1780's and 1790's. By 1800 some towns and forts were established and some areas in the eastern part of the region along the Missouri were settled.

A new era in the development of the region commenced with the Louisiana Purchase of 1803. Expeditions were sent by the U.S. Government to explore this newly acquired territory for its resources. Following further explorations, important trade routes and eventually cattle trails became established during the nineteenth century. The Texas Road, the Butterfield Stage Line, the Chisolm Trail, and the California Road stimulated the founding of trading posts and then settlements along these routes.

At present, there are over 450 sites or districts from this region included in the National Register of Historic Places. These listings include sites similar to those in the other eastern regions (houses, churches, and courthouses), together with a range of sites associated with early travel in the area, new settlers, contacts with the American Indians, and events of the Civil War.

The region has a long history related to agriculture as the dominant land use. Present day agriculture in the region includes the enormously productive feed-grain and livestock producing areas of central Iowa, much less productive general farming in eastern Oklahoma, and poultry production in the Arkansas portion. In the northern portion of the region, over 75 percent of the land area is in cropland, and a substantial part of this area is prime farm land. In the Kansas and Missouri portions, cropland represents from 50 to 70 percent of the land area. In the Oklahoma and Arkansas portions, only 15 to 30 percent of all land is used for crops but a higher percentage of farm land is used as pastures. Principal crops are corn, soybeans, peanuts, cotton, grain sorghums, hay, and fruit. Along the Arkansas River, the cropland is devoted to commercial vegetable production for local canneries because of a plentiful year-round water supply and excellent soil for pasture.

Although cropland is decreasing in many areas and improved pastures are increasing, the size of farms shows a decided increase in acreage as mechanized farming is now the rule and better fertilizers and land management give greater yields with less labor.

In the southern part of the region, where the climate is warm and humid, timber is an important resource. In recent decades, much of the cleared land has been replaced by second and third generation forests. Presently, trees are harvested for timber and wood products, furniture and fixtures, and paper and allied products.

The presence of coal in the region has been known since the 1820's. Mining was not done on a commercial scale until the Missouri, Kansas, and Texas Railroad was built through McAlester, Oklahoma, in 1872. At first, the coal was mined for use as domestic and locomotive fuels. As branch lines were built out into the various coal fields of the region, mining expanded and began producing coal for shipment to distant markets. The steadily rising production continued and reached an all-time high in 1920. However, annual production declined after 1920 as railroads began using diesel-powered locomotives. Production rose again in the late 1940's and 50's, then declined rapidly again as industry switched to oil and natural gas for fuel. The energy problems of the 1970's triggered a new increase in production, with present production nearing the production figures of 1920.

The first natural gas in the region was discovered in the Arkansas portion of the Arkoma Basin in 1902. The first productive well in the Oklahoma portion of the Arkoma Basin was drilled near Poteau, in 1910. This discovery spurred the drilling of numerous shallow wells in the 1910's and 1920's. Many of the zones are still productive or are being used for gas storage. Presently, the only oil and gas producing States in the Western Interior Coal Region are Arkansas, Oklahoma, and Kansas. In 1955, rising natural gas prices encouraged a new wave of drilling activity. Development was hampered at first by the absence of an adequate pipeline network, but new pipelines were built and drilling activity boomed through the mid-1960's. By the late 1960's, however, rapidly increasing drilling costs coupled with stagnant or slowly rising gas prices discouraged new, large-scale drilling activity. In 1973, the energy crisis forced natural gas prices upward and drilling activity increased again. Higher gas prices and steadily advancing drilling technology have encouraged drillers to seek pay zones at ever increasing depths, and new wells in a number of fields are more than 12,000 feet deep.

The tourist and recreation industry is of moderate economic importance, but the region has always been an area of high recreational use. Good roads, proximity to population centers, and publicized recreation resources and developed attractions result in heavy tourist traffic. Two national wilderness areas are located in National Forests that are partially in this region. They are Caney Creek with 14,344 acres in the Ouachita National Forest, and Upper Buffalo, encompassing 10,182 acres of the Ozark National Forest. In addition, more than 66 State parks, 40 State recreational areas, 26 State forests and preserves, and 20 other recreation areas lie within the region. Combined annual attendance for these facilities is over 19 million and their present area is 260,850 acres.

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Principal manufacturing, retail and wholesale trade centers in the region are in Des Moines, Iowa; Omaha, Nebraska; Kansas City, Missouri; Kansas City, Kansas; Tulsa, Oklahoma; Fort Smith, Arkansas; and Topeka, Kansas. These large cities are also executive centers for large business such as major oil companies, large corporations, financial and banking institutions. Total employment and earnings in each employment class during 1974 is presented in Table 5-3 along with percentage distribution.

Transportation systems have historically been an influential factor in the development of the region. The Missouri River provided the principal means of access to the west during the early portion of the nineteenth century. Later that century, development was spurred by the advent of the railroads. Today the region is served by eight major railways, barge lines, and by truck service over a widespread highway network including six Interstate Highways. Major air terminals are located in all major population centers and several cities around the region within relatively easy driving distances. Local and feeder lines are available in the smaller cities. Various electrical transmission lines, water lines, microwave paths, telephone lines, gas lines, and oil lines form a network throughout the region. There are no coal slurry pipelines in the region.

Socioeconomic data for the Western Interior Coal Region are presented in Table 5-3. The population totaled over 5.8 million in 1975 with a density of 55 persons per square mile. Farm populations vary from 11.3 to 28.1 percent among the counties of the region, with urban dwellers comprising another 58.5 percent of the total. The population was relatively stable during the 1960's with a slight gain between 1970 and 1976.

In summary, the region can be described as predominately rural, with numerous farms and ranches; a variety of second growth timbered areas, varying from small farm woodlots to managed forest tracts; numerous small rural communities and large metropolitan industrial centers; and an extensive road network which permits mobility and accessibility between them.

Land use development and settlement in the region occurred in such a manner that there are no major tracts of land under the Bureau of Land Management's jurisdiction. The only significant Federal lands in this region are the Ouachita and Ozark National Forests, which are under the jurisdiction of the U.S. Forest Service; the DeSoto, Squaw Creek, Swan Lake, Flint Hills, and Sequoyah National Wildlife Refuges, which are under the jurisdiction of the U.S. Fish and Wildlife Service; and scattered reservoirs and military bases, which are under the jurisdiction of the U.S. Department of Defense.

4.4 TEXAS COAL REGION

The Texas Coal Region is located entirely within the Gulf Coastal Plain. The region encompasses 37,000 square miles in east Texas and a small portion of northwest Louisiana. There are a total of 54 counties contained in this region. All but three of these counties are located in Texas.

4.4.1 The Environment

The Texas Coal Region has major resources, in the form of natural resources, agriculture, and industry.

Topographically, it consists of gently sloping, irregular plains and tablelands. Elevation does not exceed 1,000 feet above sea level. The area is underlain with sedimentary rock of the early Cenozoic Era of about 70 million years ago. The soils have never been glaciated. These prehistoric conditions have enabled the preservation of numerous fossil formations which are scattered throughout Texas. Many formations are closely associated with the lignite deposits.

In terms of historical geology, lignite constitutes an early stage of development. It is a low grade coal and contains separable pieces of plant material. The relatively low value of the coal is directly correlated with its recent geologic occurrence. Today's lignite deposits resulted from accumulations of plant material in river deltas, flood plains, and lagoons in the early and middle Cenozoic Era. Subsequent sedimentation compacted this organic matter to its present state.

Currently, the region's lignite reserves are estimated to be 3.3 billion short tons. Both surface and subsurface deposits exist in most counties. Generally lignite is associated with three major seams which parallel the northeast-southwest boundaries of the region. Surface lignite is associated with the Wilcox or the Yegua-Jackson Group, while subsurface lignite is associated with a seam commonly referred to as the Texas Deep-Basin deposit. Surface deposits are usually less than 90 feet deep and are often found in seams that are 10 to 20 feet thick. Many seams, however, are thinner and are thus presently unattractive for development. Texas Deep-Basin coal is found up to 5,000 feet below the surface. Most of the subsurface deposits are found in the northeastern half of the region.

Other significant mineral resources are located within this area of Texas and Louisiana. This region is a very major contributor to the nation's petroleum and natural gas production. In addition, ample iron ore, clay, sand, and gravel reserves are available to supply regional construction needs.

Soils of sandy, silty, or clay loams overlay the mineral deposits throughout the region. Soil conditions vary from acidic to basic at varying locations. The soil's organic content also varies among locations, depending not only on natural conditions but also on the particular land use. Soil moisture and consequently soil productivity varies extensively from northeast to southwest according to the degree of precipitation and irrigation.

Climatic conditions are such that the region receives about 48 inches of precipitation in the northeast but only 16 inches in the southwest. This variance is due largely in the variability in the influence of the Gulf of Mexico. The northeastern area is more heavily influenced by the subtropical winds from the Gulf. The result is a more humid climate. Proceeding southwesterly, the Gulf's influence diminishes and the region is subjected to the wind currents from interior Mexico and the Southwest. The result is thus an increasingly arid climate in the southwestern portion of the region. These conditions create periodic droughts in the southwestern portion. They do not, however, permit any measurable quantities of snowfall.

Winters are cool with daily mean temperatures ranging from 64°F in the northeast to 70°F in the southwest. Summers are hot. Record temperatures throughout the region exceed 100°F. Temperatures in excess of 100°F occur every summer.

TABLE 4-5

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
WESTERN INTERIOR REGION (a)

1975 Total Population ^a	5,883,113			
Total Area (square miles) ^a	106,957			
Population per square mile (1975)	55.0			
Per Capita Personal Income (1975)	\$5,209			
Per Capita Personal Income as a Percent of National Average (1975)	103			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	120,941	5	695,712	3
Other Agriculture	148,071	6	1,189,313	5
Metal Mining	-	-	-	-
Coal Mining	4,398	0-1	24,330	0-1
Oil and Gas	7,000	0-1	351,942	1
Other Mining	9,950	0-1	56,561	0-1
Construction	100,263	4	1,509,177	6
All Manufacturing	453,746	19	4,963,749	21
Transportation, Communication, and Public Utilities	121,222	5	2,276,548	10
Wholesale and Retail Trade	499,512	21	4,330,842	18
Finance, Insurance, and Real Estate	122,726	5	1,326,721	6
Other Services	326,544	14	3,305,990	14
Federal Govt.	120,799	5	1,458,612	6
State and Local Govt.	330,042	14	2,338,467	10
TOTAL	2,365,214		23,827,964	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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Average wind speeds are approximately 10 miles per hour and are generally southerly or southeasterly. An outstanding characteristic is their steadiness and persistence. The region is continually and consistently ventilated so that no major concentrations of air pollutants (sulfur dioxide, nitrogen dioxides, and particulates) are found within its boundaries. Minor concentrations of particulates do, however, occur at Waco, Tyler, Austin, and San Antonio, Texas.

Like the climate, the region's water characteristics change from northeast to southwest. Runoff is substantial in the northeast (up to 16 inches a year), but is essentially nonexistent in the southwest (down to 1 inch a year). Potential evapotranspiration in the area is highest of all the regions, averaging 42 inches a year over most of the region and exceeding 54 inches a year in the extreme southwest.

Numerous streams, including the Sabine, Brazos, Red, Neches, Trinity, Colorado, and Nueces Rivers, drain the region and empty into the Gulf of Mexico. The combined flow of these rivers and their tributaries is 61.5 million acre-feet per year. Stream sediment levels decrease to the northeast as precipitation and runoff increase. Total dissolved solids range from 270 to over 1,900 milligrams per liter in streams in the western part, and from less than 350 to over 1,200 milligrams per liter in eastern parts of the region. Streams in the area may carry up to several thousand milligrams per liter in areas affected by salt seeps and oil-field activities. Of the total surface water withdrawn, 15.5 million acre-feet are consumptively used each year, primarily for irrigation and industry.

Groundwater is abundant and of good quality. Very high yields, over 1,000 gallons per minute, have been reported from both bedrock and alluvial aquifers. The water generally contains less than 500 milligrams per liter of total dissolved solids, but quality deteriorates with increasing depth. In the southwestern part of the area, some natural groundwaters contain high levels of trace metals and fluoride. Additionally, groundwater quality has been affected in some areas by oil-field activities. Groundwater use in the region is approximately 75,000 acre-feet per year, primarily for public and industrial water supply.

The interplay of these environmental factors contributes to considerable ecological diversity within the region. From northeast to southwest there is a transition in natural vegetation from oak-hickory-pine forest, to oak-hickory forest, to mesquite-oak savannah, and lastly to mesquite-acacia savannah. Of the forest species blackjack oak, post oak, and shagbark hickory, associations are the more prevalent. Much of the natural vegetation is presently thriving, as approximately 30 percent of the total region is forested.

The primary tree species in the forests are loblolly pine, shortleaf pine, and longleaf pine. The vegetation of the region's flood plains differs, however. Cypress, sweetbay, maidencane, cattails, pondweeds, alligator weed, and watermilfoil are dominant plant species in these locations. Mixed shrubs and grasses are the most common types of flora in the mesquite savannahs. In addition to mesquite and acacia, major species include yucca, juniper, little bluestem, gramma, wheatgrass, needlegrass, and buffalograss.

The diverse associations of flora serve as habitats for a variety of wildlife populations. For example, populations of raccoon, fox squirrel, wild turkey, and red-eyed vireo thrive in

the forests while populations of bobwhite, ringtail cat, eastern cottontail, and fulvous harvest mouse thrive in the savannahs. Species common throughout the region include armadillo, coyote, peccary, and whitetail deer. Major fish species include catfish, minnows, shiners, and various gamefish, such as black bass, crappie, spotted bass, and sunfish.

Most of the species that exist in the region have proven to be somewhat compatible with man. Some species, however, are more adaptable to human habitation. They are, therefore, common in areas that border agricultural, natural resource, or community developments. Other species are more sensitive to human activity. Their populations have diminished to the point where they are rare or in danger of extinction. Federally listed endangered species of wildlife include the Houston toad, Mexican duck, whooping crane, peregrine falcon, bald eagle, red wolf, American alligator, Backman's warbler, and fountain darter. Presently, there is only one species of plant listed as endangered by the U.S. Fish and Wildlife Service. This is Texas wild rice. Numerous other plants are under consideration for designation as endangered. They may eventually be listed as threatened or endangered.

The ecosystems within the Texas Coal Region are not particularly fragile. The forests and savannahs can sustain a degree of disruption and eventually return to a natural state. This is presently being demonstrated in areas where there was earlier widespread clear-cutting of deciduous and coniferous forests. Within decades these lands became reforested through natural successions. Disturbed vegetation may take many years to mature to an oak-hickory climax forest similar to original virgin timber. Nevertheless, immature oak-hickory-pine associations can reoccur naturally within 50 years. Mesquite savannahs can regenerate even more quickly. Additionally the gently rolling topography is not overly vulnerable to erosion, although localized erosion problems exist, particularly in the southwestern portion of the region. In summary, the ecosystem within the Texas Region could be reclaimed with proper management, should the surface be disturbed by coal mining.

4.4.2 The Environment and Man

The natural resources of the Texas Coal Region have historically attracted mankind. Prior to the European colonization of North America, the region supported Indian populations from the Caddo, Wichita, Tonkawa, Lipan, and Desert Tribes. Hunting was the main means of survival. Bison, deer, and smaller birds, mammals, and reptiles were primary food sources.

The land did not see Europeans until the sixteenth century. In 1542 a Spaniard named Mosoco, who had been a member of De Soto's party, entered the Texas Region from the northeast, proceeded southwesterly to about the center of the region, and then returned by the same route. Mosoco's exploration initiated Spanish colonization of the area.

Over the next three centuries Spanish colonists were attracted to the area by the extensive land with ample opportunities for small farming. By the nineteenth century, the productivity of the land also proved attractive to the westward expanding States. English speaking people began migrating to the area. Conflicts resulted between the Spaniards from Mexico and the Englishmen from the States. War eventually

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resulted with troops lead by Sam Houston and Santa Anna. The Mexicans were defeated, and the U.S. obtained possession of the land. After 10 years as an independent republic, Texas joined the Union in 1845.

By 1850, the northeastern half of the region had been settled by westward migrating pioneers. The area's flood plains were settled first because of their agricultural productivity and proximity to water. Timber and clay resources were more than adequate to supply all needs for construction materials. By 1890 cities and towns were scattered throughout the region. The region proved especially attractive to ranchers and farmers. The vast grasslands of the southwestern portion could readily support cattle or sheep, and extensive ranches were developed in this area. In the wooded territory of the northeast, some of the land was cleared for pasture or the cultivation of cash crops. The central ecotone between the grassland and forestland (mesquite-oak savannah) supported both farming and ranching. Environmental conditions permitted the widespread cultivation of cotton in the northeastern central areas. Much of the land still supports cattle and sheep production and the cultivation of cotton and other cash crops. Currently, approximately 54,000 persons, or about 10 percent of the total regional work force are employed in the agricultural sector.

The vast stands of virgin timber in the northeast continue to be highly productive. Extensive lumbering operations began about 1880. The economics of the industry, at that time, required the harvesting of only large diameter trees. Within decades, however, construction material and paper demands grew with the population, and all timber stands became valuable. By 1930, all virgin timber stands had been harvested. Presently, timber demand still is high particularly for pulpwood production in the northeast; however, primarily second and some third generation timber is being harvested.

In addition to timber, numerous other resources were developed for use as twentieth century construction material. Clay for brick manufacturing is plentiful in the area. Ample sand and gravel supplies are available for use as cement for building or concrete for highways. Large deposits of iron ore are found throughout the northeastern portion. The ore is a low grade brown ore, but is being actively mined for use as a highway construction material.

Perhaps the most attractive natural resources within the Texas Coal Region are the energy minerals. In addition to lignite, oil and gas are abundant. Texas became the leading State in the country for production of both oil and gas. Much of these resources are produced within the boundaries of the Texas Coal Region. The region is presently producing more oil and gas than it consumes, and contributes significantly to the country's energy demands. The low grade lignite found within the region has not been economically competitive with oil and gas. Until recently, the higher grade bituminous and anthracite coals were of greater economic value to industry. Accordingly, no major development of the region's lignite deposits has occurred to date. Scattered localized development of lignite, however, is occurring for intraregional industrial use. Industries are, however, becoming interested in lignite development.

The demand for the region's numerous resources also created a demand for a transportation network with the capacity to accommodate the movement of bulk commodities,

as well as people and their necessities. The entire region is crisscrossed by a diversified network of rail main lines and branch lines operated by the Missouri Pacific, Southern Pacific, St. Louis Southwestern, Atchison Topeka and Santa Fe, Louisiana and Arkansas, Texas and Pacific, and Missouri-Kansas-Texas railways. The region's highway network is composed of numerous county, State, and Federal highways, all of which can lead eventually to access to the major Interstate Highways. The pipeline system is composed of oil and gas lines. No coal slurry pipelines are located in the region.

Natural resource development has led to dramatic socioeconomic changes for the region during the twentieth century. Table 4-6 presents pertinent socioeconomic data which provides information on the relative importance of specific sectors of the region's economy. In addition to rural development, community and urban growth has been inspired by resource-dependent industry. Industrial growth has been and still is dynamic phenomenon in the region. Currently, approximately 150,000 workers, or about 17 percent of the total regional labor force, is in the manufacturing sector. Industrial growth concentrations include Tyler, Longview, Bryan, and San Antonio, Texas, and Shreveport, Louisiana. These cities are absorbing growth in a relatively organized manner.

The resource-oriented economic base of the region has brought prosperity to the Texas Coal Region. Surplus resources are exported, thereby resulting in an influx of revenues. Regional capital, together with an adequate labor pool, has been capable of supporting industrial development. They are available for continued resource development.

Cultural development within the Texas Coal Region provides the area with an interesting history. Indian artifacts can be found throughout the region. Historical sites from the Alamo to Lyndon Baines Johnson's boyhood home are located within its boundaries. Approximately 150 such sites are listed on the National Register of Historic Places. The Chisholm and Old Cattle Trails, currently proposed for the National System of Trails, are being considered for protection and preservation.

The region's population growth and settlement patterns have been such that no surface land ownership is presently under the Bureau of Land Management's jurisdiction. The only Federal lands in the region are the Sam Rayburn Reservoir and the Somerville Reservoir, which are under the jurisdiction of the U.S. Department of Defense and portions of the Sabine, Davy Crockett, Sam Houston, and Angelino National Forests, which are under the jurisdiction of the U.S. Forest Service.

4.5 POWDER RIVER COAL REGION

The Powder River Coal Region is the southwest portion of the Northern Great Plains coal province. The region encompasses about 31,300 square miles in seven Montana counties and six Wyoming counties.

4.5.1 The Environment

The region is on a broad plain bordered by the Rocky Mountains on the west, the Black Hills uplift on the east, and the Missouri River on the north. The area is covered primarily

TABLE 4-6
POPULATION AND ECONOMIC CHARACTERISTICS IN THE
TEXAS REGION (a)

1975 Total Population ^a		2,526,616		
Total Area (square miles) ^a		45,900		
Population per square mile (1975)		55.1		
Per Capita Personal Income (1975)		\$4,398		
Per Capita Personal Income as a Percent of National Average (1975)		87		
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	28,613	3	126,314	2
Other Agriculture	52,818	6	167,179	2
Metal Mining	270	0-1	2,623	0-1
Coal Mining	672	0-1	3,149	0-1
Oil and Gas	14,191	2	231,256	3
Other Mining	1,657	0-1	5,099	0-1
Construction	52,274	6	533,911	7
All Manufacturing	149,330	17	1,471,359	18
Transportation, Communication, and Public Utilities	31,239	3	524,726	6
Wholesale and Retail Trade	182,096	20	1,381,368	17
Finance, Insurance, and Real Estate	35,398	4	349,263	4
Other Services	113,792	13	1,164,056	14
Federal Govt.	104,125	12	1,275,904	16
State and Local Govt.	130,791	15	914,083	11
TOTAL	897,266		8,150,290	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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with the thin stony deposits characteristic of a semi-arid area, with recent alluvial deposits and terrace gravels in the floodplains. These alluvial deposits of sand and silt with lenses of gravel usually occur in thicknesses up to 15 feet along the major rivers of the area and 10 to 15 feet along the tributaries.

Rocks are mostly sedimentary, and rest nearly horizontal except along the flanks of the Bighorn Mountains where they turn up sharply. The sedimentary rocks consist of several thousand feet of sandstone, shale, limestone, conglomerate, and beds of sub-bituminous coal. Some of these beds were deposited on the floors of ancient seas that extended across the continent; others were deposited in deltas or tidal areas along the margins of the seas or inland in broad basins. Coal formed in tidal swamps and marshes along the marine shores, and also in swamps and lakes on the flood plains of major drainage systems of inland basins which developed after the continents were uplifted and the seas retreated. Coal of commercial interest is contained in the Tongue River member of the Fort Union Formation and the overlying Wasatch Formation.

In general, the coal beds are thickest in the northern parts of the region and across the gently dipping northern and eastern sides of the Powder River basin in Wyoming. A large proportion of this coal lies in near-surface beds that are readily available to surface mining. The region contains approximately 141.5 billion tons of sub-bituminous coal resources.

The thickness of these beds is unsurpassed anywhere in the U.S. The Wyodak seam in the Wyoming portion of the basin is as much as 120 feet thick, and contains 130,000 tons of coal per acre within a few feet of the surface. In the central parts of the region, south of the Yellowstone River in Montana, there are several beds with equally abundant coal in near-surface seams.

In addition to coal, extensive deposits of oil and gas are found in the Wyoming portion of the region and in Montana around the Bull Mountains. Uranium is also found in the Wyoming portion. Underlying the entire Powder River Coal Region south of the Yellowstone is the Madison Group, which is considered the top part of the major aquifer of the basin. This aquifer dips very steeply off the flanks of the Bighorn Mountains to a point about 15,000 feet below the surface. The Madison Group rises gently from this point toward the Yellowstone River and the Black Hills where it outcrops. The Madison Group is about 200 feet thick near the south end of the basin and gradually thickens toward the Yellowstone where it is up to 1,400 feet thick.

The regional climate is continental and semi-arid. Frontal systems from the Pacific regularly cross the area, but have dropped most of their moisture on the western slopes of the Rocky Mountains. About a dozen times a year, winter storms from the north swing through the area, bringing windy and often intensely cold weather with rarely significant moisture. These cold waves are often modified by periods of milder weather created by "chinook" winds. These winds, warm and dry, frequently reach 25-50 mph and may persist for several days. Spring and summer bring some moisture; however, the area is considered dry.

The average annual temperature varies little throughout the area, with most points averaging 45°F. Maximum temperatures occur in July when 100°F temperatures are

recorded. The arctic outbreaks in winter bring extreme cold in January and February, with record lows in many areas of -50°F.

Seventy-five percent of the average annual precipitation of 14 inches falls between April and September. At least half occurs during late spring and early summer, at the start of the growing season. Despite the region's aridity, flooding is common in the spring when rapid snow melt produces heavy runoff.

Perhaps the most important climatic feature in shaping the region is the recurring cycles of drought. Though this region is characterized as semi-arid, it varies from humid in some years to arid in others and is never predictable.

The region is windy, with average speeds of 10-13 mph. The prevailing direction is westerly, but directions near terrain features may vary considerably. Surface-based inversions occur on 75-85 percent of the mornings, summer and winter; and on winter afternoons, surface based inversions occur about 35 percent of the time. Stable conditions are prevalent in spite of generally windy conditions, and these circumstances contribute to the high summertime afternoon mixing heights.

Air quality in the region is generally good. Some variations do exist around populated areas and even more so in areas where coal surface mining is presently taking place. In Montana, the particulate air quality is very good except for the Colstrip area in Rosebud County and the Billings area in Yellowstone County. The Colstrip area, where surface mining and electric generation are taking place, is not meeting the primary standard for particulates. The Billings area is not meeting the secondary standard. Particulate air quality in the Wyoming counties is better than the national standards. However, in areas where substantial coal surface mining is taking place (such as Campbell and Converse counties in Wyoming), the air quality in the immediate area of the mine site may not be as good. Sulfur dioxide air quality is better than the national standard throughout the region.

The major streams of the region are the Yellowstone, Big Horn, Powder, Tongue, Belle Fourche, and Musselshell Rivers. Surface reservoirs for regulation of streamflow have a combined capacity of about 2.5 million acre-feet. Surface water runoff is low, about half an inch per year. Potential evapotranspiration over most of the area is less than 24 inches a year, but in the Yellowstone River lowlands it rises to as much as 36 inches.

Surface water quality is variable. The Powder and Big Horn Rivers commonly carry concentrations of dissolved solids in excess of 1,000 mg/liter. Streams with heavy sediment load are the Tongue and the Yellowstone, ranging from a low of about 270 mg/liter to a high 1,900 mg/liter. Over the remainder of the area, the sediment loads are variable and can exceed 1,900 mg/liter.

The occurrence of groundwater in the region is far from uniform. In Montana, there are large areas where shallow wells will yield only 2 to 4 gpm, but wells drilled into the bedrock aquifers, such as the Hell Creek and Fox Hills Formations (Cretaceous) or the Fort Union (Paleocene) may yield more than 50 gpm. Many wells drilled in the Powder River and Yellowstone River Valleys flow under artesian pressure, but lowering of artesian pressures sometimes necessitates pumping. Much of the southern and southeastern

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region is underlain by several thousand feet of non-productive shales. Groundwater can be produced at a rate of up to several hundred gpm from wells in permeable valley fills along major streams. The greatest development of these alluvial deposits is along the Yellowstone River and its tributaries.

The Madison limestone formation underlies the region at considerable depths, and is currently being tested by the U.S. Geological Survey as a potential source of water supply for the coal industry. Recent studies indicate that the water is chemically suitable, but the quantity available for withdrawal is unknown.

Groundwater quality is variable. Generally, at depths greater than 500 feet, all groundwater has more than 1,000 mg/liter of total dissolved solids. The amount of groundwater withdrawn in 1975 for consumptive uses was about 124,000 acre-feet, of which about 34,000 acre-feet was actually consumed. The largest use was for irrigation, and the second largest use for self-supplied industries.

Groundwater in storage is low (about 1.4 million acre-feet) in the nearsurface alluvial aquifer material. Estimated reserves from the deep Madison limestone, however, exceed 13 million acre-feet.

Topographically, the region can be divided into three general areas: the Powder River drainage in Wyoming, the Tongue River drainage in Montana, and the area north of the Yellowstone River. The Wyoming area drained by the Powder River has gently undulating topography with clay and loam soils that have a large amount of sodium in the clays. These soils are dry much of the year and their relative productivity is poor. Exceptions are the locally important and more productive soils associated with flood plains of the Powder River, Little Powder River, and lesser tributaries. These flood plains with alluvial soils are often broadly terraced and have high water tables. Typical flood plain vegetation includes cottonwood, willow, green ash, boxelder, chokecherry, greasewood, salt grass, and western wheatgrass. Wildlife ranging over many miles of the adjacent plains rely on these flood plains for critical resource needs.

The remainder of the Wyoming portion of the region can be generally classed short-grass prairie, grassland-sagebrush, and sagebrush steppe. These vegetation types may seem monotonous and unproductive. They are, however, a complex assemblage of plants that are well adapted to the extremes of weather which occur in the area. Lying dormant during periods of drought, they are capable of quick response to precipitation, producing significant quantities of foliage of high nutrient value. Besides the common grasses and sagebrush, there is an abundance of forbs that increase the species diversity and resilience of the vegetative community, which in turn supports a diverse assemblage of animals.

North of the Wyoming border in the Tongue River basin and the lower reaches of the Powder River there is a change in topography and an associated change in soils, vegetation, and wildlife. The dominant soil in the Tongue River basin is loam with fair to very good productivity. The area is highly dissected by numerous small drainages dominated by two major vegetation types, grassland-sagebrush and ponderosa pine. The ponderosa pine type occurs on uplands, ridges, and north slopes that have shallow loam soils. Prominent species of plants are ponderosa pine, snowberry bluegrasses, fescues, and June grass.

North of the Yellowstone, the Powder River Coal Region is dominated by soil types not found south of the river. The undulating to hilly land has shallow to moderately deep loamy soils that are nearly always dry and hence have low productivity. These lands are vegetated by the mid-to-short-grass prairie type, characterized by such species as western wheatgrass, needle and thread grass, and blue grama grass. On the northern border of the region along the Missouri River are the "Breaks", highly dissected land forms similar to the Badlands in North and South Dakota.

In general, the region can be considered part of the short-grass prairie. The high annual turnover of net primary production in its grasslands and sagebrush steppe communities provides a food base for a wide variety of mammals. Grazing animals, burrowing mammals, and ground-nesting birds are characteristic of the grasslands. Insect life is abundant, varied, and heavily utilized as food for many secondary consumers. Sagebrush is prominent in the vegetation composition in parts of the grassland, especially in the southern part of the region, and is important to pronghorn antelope and Brewer's sparrows and virtually essential to sage grouse. Large herbivores such as bison and antelope were present in great number during presettlement times. Today, bison have been replaced by domestic livestock as the primary grazing animals and horses, cattle, and sheep often compete with herbivores.

Practices used in livestock production have sometimes disrupted the grassland ecosystem to the detriment of various wildlife species. Examples are predator and rodent control programs and sagebrush eradication in antelope or sage grouse wintering areas. Antelope are still numerous in the grasslands; investigations have shown that they are highly dependent on the brush and forb components of the grassland for survival. Typical smaller mammals include the masked shrew, white-tailed jackrabbit (northwest), black-tailed jackrabbit (southeast), desert cottontail, black-tailed prairie dog, northern pocket gopher, the plains pocket gopher (south), coyote, swift fox, long-tail weasel, badger, and prairie spotted skunk. Reptiles include the prairie rattlesnake and eastern short-horned lizard. Birds include the ferruginous hawk, prairie chicken, sharp-tailed grouse, mountain plover, burrowing owl, horned lark, western meadowlark, lark bunting, savannah sparrow, grasshopper sparrow, vesper sparrow, and MacCown's longspur. Drought and severe winter storms occur periodically, and some animal populations can fluctuate widely from year to year.

In the ecotone area between the montane coniferous forest and the grasslands, animal species characteristic of the coniferous forest and of the forest edge will often be found. Some of these animals, such as mule deer and elk, also occur in extensions or scattered islands of coniferous forest and related subtypes within the grassland. Typical mammals of the coniferous forest and forest edge include the yellow-bellied marmot, golden-mantled ground squirrel, least chipmunk, red squirrel, bushy-tailed wood rat, boreal redback vole, porcupine, mule deer, elk, and bobcat. Birds include the golden eagle, Clark's nutcracker, mountain chickadee, mountain bluebird, and pygmy nuthatch.

The deciduous forest edge extends into the shortgrass plains along stream drainages. As the interior of the continent grew arid in prehistoric times, many species of deciduous trees

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together with their associated animals were able to persist along the stream. These tongues of forest greatly extend the forest edge, increasing the number of species that can live in the grasslands. Some species are common to the deciduous forest edge over most of its range, and others are found only in the western portion of this type. Typical mammals in these areas include the fox squirrel, eastern cottontail, whitetail deer, red fox, striped skunk, and raccoon. Reptiles include the blue racer, milk snake, and red-spotted garter snake. Birds include the turkey vulture, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, Swainson's hawk, mourning dove, common nighthawk, red-shafted flicker, violet-green swallow, common crow, black-billed magpie, loggerhead shrike, and Brewer's blackbird.

Aquatic wildlife includes a variety of invertebrates, fishes, birds, mammals, reptiles, and amphibians associated with the stream, lake, and pond-marsh communities. Typical inhabitants of stream riffles and sand-bottom pools are caddisfly larvae, mayfly naiads, stonefly naiads, crayfish, and snails. Characteristic species include the longnose dace, flathead chub, goldeye, river carpsucker, black bullhead, channel catfish, stonecat, plains topminnow, plains killfish, and white sucker. Rainbow and brown trout are found in suitable larger streams. Other stream-associated wildlife include the tiger salamander, plains spadefoot toad, great plains toad, leopard frog, and snapping turtle. Muskrats use burrows in stream banks and feed on streamside vegetation. Beaver feed on the aspen, willow, and cottonwoods along stream courses and in some localities build dams creating pools.

Species characteristic of the few lakes in the region include yellow perch, largemouth bass, black crappie, and carp. In deeper, cooler lakes, rainbow trout are often planted and maintained by man. A number of birds commonly inhabit the lakes and subsist mainly on fish. Common mergansers, California gulls, bald eagles, white pelicans, and osprey are among them. Swallows consume great numbers of emerging midges and other insects.

The only wildlife species in this region that are classified as endangered are the black-footed ferret and peregrine falcon. In addition, the prairie falcon is considered threatened. Some species, while not endangered throughout their range, have remnant populations in danger of being eliminated in local areas. This has prompted some states to develop "rare and endangered" species lists. Wyoming's list includes such species as the shovelnose sturgeon chub, kit fox, upland plover, and western smooth green snake, all of which occur within this region. There are no plant species currently listed as endangered or threatened. However, some species found in this region currently are being considered for inclusion.

4.5.2 The Environment and Man

The earlier dwellers of the plains are believed to have been the Paleo Indians of the Big-Game Hunting Tradition.

Although not well documented within this region, the Paleo-Indian big game hunting tradition of the pre-8000 B.C. period can be characterized by sites such as Brewster and Hell Gap immediately to the east and southeast of the region. The Hell Gap site in Niobrara County, Wyoming, produced evidence of several occupation levels to approximately 9000

B.C. This region is in the transition area from the Eastern Archaic to the western Dester Culture, occupied in the pre-1000 B.C. period by the Middle Prehistoric cultural complex. The final cultural development produced the Plains Bison Hunter complex that was ancestral to the tribal groups encountered by early European explorers. The most common evidence are the piles of buffalo bones found at the base of small cliffs. The area is rich in archeological resources but remains largely uninvestigated with no major systematic program having been undertaken. Most identified sites were found by accident or were attempts to salvage sites being developed for mining, industrial, or urban uses.

The first non-Indians to enter the region were seeking beaver. Men like Jim Bridger and Will Sublette came into the land as explorers and trappers and became trail blazers who led pioneers across the great American desert to the California gold fields and the lush Willamette Valley in Oregon Territory. Most of the early pioneers passed through the region believing that it was unsuitable for their agrarian culture. Settlers headed for California and Oregon passed through during this period. The gold rush to California started in 1849 and persisted until 1870. The Montana gold strike was in 1865 and it attracted more people through the area.

The influence of the non-Indian culture in the plains grew rapidly. The development of the telegraph, railroads, cattle drives, and the passage of the first Homestead Act in 1862 began the process which eliminated the vast buffalo herds. Two tribes, the Crow and Northern Cheyenne, occupied the region beginning in the 17th Century. Both tribes were a mobile society depending on the buffalo for a significant part of their consumptive needs. Both tribes signed the Friendship Treaty of 1825 and the Ft. Laramie Treaty of 1851, both of which were violated by non-Indians. These violations led to conflict. The most famous of this period is the 1876 Battle of the Little Big Horn where General Custer and his troops were killed. Many historic remnants of this period have been preserved. In addition to the Custer Battlefield, there are many U.S. Army Forts still found in the area.

The Northern Cheyenne and Crow were unsuccessful in their attempts to retain the lands granted to them in the earlier treaties and eventually agreed to move onto their present reservations. The Northern Cheyenne Tongue River Reservation, consisting of 371,200 acres, was established in 1884. The name of this reservation has been changed to the Northern Cheyenne Indian reservation and has been expanded by Tribal land purchases to 444,308 acres.

The treaty of Ft. Laramie granted the Crows a hunting reservation of 38,883,174 acres in Montana and Wyoming. In 1868 the Federal Government reduced this to 9 million acres which lie primarily in Big Horn County, Montana. Sales by the Crows and further reductions by the U.S. Government reduced the Crow reservation to 1,569,288 acres.

Stock raising in the Powder River Coal Region became a booming business which grew rapidly between the civil war and the 1880's. At first it was based on a free open range with the only constraint being the number of head a group could put together and the availability of stock water. The scarcity of water was immediately evident. Development of springs, small retention dams on intermittent streams, and the windmill are still the critical links in the chain that makes the

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region's grazing lands useful. Conflicts over the use of western water continue to this day even at the national level.

In the early days of ranching most cattle were left on the range year round. Although winter feed was limited, most cattle survived and reproduced in sufficient numbers to maintain a viable economy. Records show that the period from the end of the civil war until the end of the 1880's was a period of unusually high precipitation. The condition of the range and the availability of winter forage were significantly higher than could be normally expected. However, in the late 1880's, particularly the winter of 1886-87, the growing cattle empires suffered devastating losses. Severe cold and high winds killed hundreds of thousands of animals.

Cattlemen partially addressed this problem by insuring a good supply of winter feed. They accomplished this by converting bottomlands to irrigated hay meadows, the mainstay of the industry yet today. Simple one man stream diversions grew to cooperative efforts between neighbors to large ditch companies that not only built and maintain diversion and delivery facilities but also reservoirs to store the spring runoff for use during the summer and late fall. By the 1890's irrigation systems could be found in most of the areas where their development was practical and economical. The opportunity to develop irrigated haylands was not as available in the southern part of the region. Therefore, many ranchers in this region still depend on the range for winter feed often supplemented by hay purchased from other areas.

The cattle industry of today is essentially the same as it was at the turn of the century. The ranches as they now exist in the area are large. Average size for Campbell and Converse Counties, Wyoming, is over 7000 acres. Most of these ranches are self-contained, but some ranchers move cattle and sheep from their base ranches to summer ranges on public lands located some distance away. Most units utilize some State or Federally owned surface rights. Machinery has replaced much of the hand labor; smaller outfits have been absorbed by larger ones; and local owners have in some instances been bought out by corporations. For those people on the land their life is much the same as those of their grandfathers and grandmothers who settled the land. Hay is irrigated and cut and stacked in the summer and fall. Cattle are rounded up in the fall, fed on the home place over winter, and transferred to the range for the summer where they feed and grow on native vegetation.

The weather and the markets, however, are unpredictable and they have brought cycles of plenty and despair. Drought has been a recurring event; besides the well-known drought of the thirties, the land also dried up in the 1910's, 1950's, and 1970's.

Many of the settlers who began to enter the region after the turn of the century came to farm. As a result, much of the land in the region has been used to produce dryland crops, particularly wheat. However, the soils and the rainfall are marginal at best and, except for those farms that are irrigated, like those along the Yellowstone River, a cycle of boom and bust has been the rule. During periods of drought, wind erosion starts and tons of soil, developed over thousands of years, are lost in a matter of days.

The last few decades have shown a variability in amount of dryland farming, crop yields, and crop failures. During the 1920's, drought drove many homesteaders off the land. The

Federal Government, operating under the National Industrial Recovery Act of 1933, Emergency Relief Act of 1935, and the Bankhead Jones Act of 1937, reacquired many of these eroded lands and replanted them with forage plants. Some of these lands have been included in the Thunder Basin National Grasslands in the southern part of the region.

Although ranching and farming are the life style, and constitute the economic activity generally associated with the region, the exploitation of oil, gas, and uranium have made significant economic contributions, particularly in the Wyoming portion of the region. Table 4-7 presents an overview of comparative data for the various sectors of the region's economy.

Oil and/or natural gas have been discovered in more than 200 fields within the Wyoming portion of the region, and active exploration continues. Most of the fields produce from either the Muddy Sandstone of Cretaceous age or the Minnelusa formation of Pennsylvanian age. The Cloverly formation of early Cretaceous age is also an important producing horizon and lesser amounts of oil and/or natural gas come from Sundance, Morrison, Mowry, Turner, Niobrara, Shannon, Sussex, Parkman, Ferguson, and Teapot sandstones.

From the first significant oil discovery at Big Muddy Field in 1916 until January 1, 1973, production has been more than 400 million barrels of oil and about 400 billion cubic feet of gas. The remaining recoverable reserves in the region are conservatively estimated at more than 200 million barrels of oil and more than 500 billion cubic feet of natural gas.

Of the known fields, 66 are actively producing and 44 are classified as temporarily nonproductive. A majority of the nonproductive fields are shut in, waiting for secondary or tertiary recovery procedures or reactivation to be implemented.

The average area used by oil well facilities including pumper, separator, ponds, pipelines, and access roads, does not exceed 15 acres per square mile. Where several wells share land facilities or are developed with spacing, the area required is less than 5 acres per square mile.

Uranium ore occurs in two mining districts in the Wyoming portion of the region: the Pumpkin Buttes district in Campbell, Converse, and Johnson Counties, and the Southern Powder River Basin district in Converse County. Host rocks for uranium ore in the Pumpkin Buttes district are sandstones in the Wasatch Formation. In the Southern Powder River Basin district the ore occurs in sandstone in the upper part of the Fort Union Formation and in the sandstones in the Wasatch Formation.

The uranium industry of Wyoming began in the Pumpkin Buttes district with the discovery of ore-grade uranium in 1951, and the first commercial production began in 1953. Early mining was for high-grade deposits at or near the surface, from pits generally less than 100 feet deep and less than 5 acres in extent. Between the years 1953 and 1967, 36,737 tons of ore containing 208,143 pounds of uranium were mined from 55 mines in Campbell County. By the late 1960's accelerated exploratory activity resulted in discovery of significant ore bodies in the Southern Powder River Basin district.

Uranium is not presently being mined in the Pumpkin Buttes district, but three mines are producing in the Southern

TABLE 4-7

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
POWDER RIVER REGION (a)

1975 Total Population ^a		228,418		
Total Area (square miles) ^a		49,424		
Population per square mile (1975)		4.6		
Per Capita Personal Income (1975)		\$5,648		
Per Capita Personal Income as a Percent of National Average (1975)		111		
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	6,175	7	49,958	5
Other Agriculture	2,606	3	36,911	4
Metal Mining	246	0-1	4,081	0-1
Coal Mining	590	1	13,013	1
Oil and Gas	3,385	4	79,644	8
Other Mining	636	1	4,380	0-1
Construction	5,145	6	104,924	10
All Manufacturing	6,379	7	103,766	10
Transportation, Communication, and Public Utilities	4,422	5	117,568	11
Wholesale and Retail Trade	22,541	26	188,883	18
Finance, Insurance, and Real Estate	3,058	4	35,714	3
Other Services	13,105	15	143,799	14
Federal Govt.	3,713	4	49,145	5
State and Local Govt.	14,314	17	106,469	10
TOTAL	86,315		1,038,255	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

Powder River Basin district from open pits. One company has begun development of underground mines.

The Powder River Region is surrounded by recreational resources of unique national significance. The Black Hills, Teton Park, the Bridger Wilderness, the Dakota Badlands, and Yellowstone Park annually attract millions of people. These tourists frequently travel the Powder River Coal Region and experience its natural resources. Its' primary attributes are clean air, open vistas and a kind of solitude not found in many areas. The region is sparsely populated; population density averages 6 people per square mile. Many of these are concentrated in major trade centers like Billings, Sheridan, Gillette and Casper. The low population levels enhance the quality of the recreational activities of camping, fishing, and hunting. Many farmers and ranchers become guides and this kind of part-time tourist industry has had small but important economic benefits to ranchers. The major economic benefits, however occur to the motel and restaurant operators who provide services to the tourists as they pass through the region to the parks and forests on the edges of region.

The lifestyle of the area is clearly western; cowboy boots, pick-up trucks, and big hats are the practical symbols of this lifestyle. As the rest of the nation is characterized by the mobility of the people, this area's common attribute is the stability of large segments of the population. A ranch, drug store, or farm equipment dealership may have been operated by the same family for several generations.

Overall population growth has been very slow during the last several decades. There have been local booms in towns like Gillette and Sheridan and some counties have experienced population losses, but overall the population can be considered stable. The influx of oil and gas developers has at times temporarily disrupted this stability in local areas but these booms have been relatively minor; most of the newcomers leave after a few years and those who stay soon take on the lifestyle of the area.

In recent years, coal and uranium developments have begun to accelerate. These types of development activities are much more extensive. They require more people, more land, and more water. New mines have opened around Gillette and increased its population. In addition to coal mining, coal conversion plants are being built, like those at Colstrip, Montana. With this kind of population influx the stability of the old structure is being radically changed.

Control of the political and economic system is shifting from the rural citizens to the new urban population. Many new private and public facilities are being constructed, increasing the opportunities and services available, but for the established residents of the area they are different and they are controlled by a new establishment.

4.6 GREEN RIVER - HAMS FORK COAL REGION

The Green River - Hams Fork Coal Region is composed of two contiguous coal regions covering 37,500 square miles of extreme western Wyoming and northwestern Colorado, with small portions in Utah and Idaho.

4.6.1. The Environment

The Green River-Hams Fork Coal Region is part of the Middle Rocky Mountain province, characterized by complex mountains with many inter-mountain basins and plains. The area is a series of parallel mountain ranges and valleys. Local relief may be as much as 2,000 feet, but is more commonly less than 1,000 feet.

The Green River subregion encompasses an area of about 17,000 square miles in southwestern Wyoming and northern Colorado, and includes several separate structural units. The Green River basin occupies the western section, separated from the Great Divide basin to the east by the large Rock Springs anticline. Coal-bearing rocks here are the Mesaverde group, including the Rock Springs and the Lance Formations; the Fort Union Formation; and the Wasatch Formation. In the Colorado portion of the field, the Iles and Williams Fork Formations contain the Mesaverde Group coal beds. The coal bearing section of rocks is several thousand feet thick and is composed mainly of sandstone with beds of siltstone, shale, and coal.

Coal beds range in thickness from a few inches to 42 feet and rank from sub-bituminous C to high-volatile bituminous C, with coals of higher rank occurring locally in areas of igneous intrusives and intense structural deformation. In past years, the high quality coals of the Mesaverde Group have been the most extensively mined and the most important in the area. Coal beds in most parts of the region are deeply buried and may never be of economic potential.

A total of 130 coal beds has been mapped in the coal-bearing Mesaverde and Medicine Bow Formations, the Ferris Formation, and the Hanna Formation. The beds are sub-bituminous C to high-volatile bituminous C in rank. They range in thicknesses from 8 feet in discontinuous beds in the lower formations to 35 feet in the Hanna Formation. The Hanna Basin area is characterized by rugged surface features. The Rock Creek coal field adjoins the Hanna Basin field on the southeast and contains coal beds ranging in thicknesses of 9.5 feet in the Hanna Formation and 8 feet in the Mesaverde Formation. Large areas of the surface are covered with gravel, and the coal-bearing rocks are difficult to trace.

The Hams-Fork Coal Region is in the extreme western part of Wyoming and includes small parts of Utah and southeastern Idaho. The coal-bearing rocks crop out in long narrow belts extending from the mountainous region in the north to the less rugged southern region near the Utah-Wyoming border. The area lies in the highly complex Wyoming overthrust belt, an area of current interest for its high potential for oil and gas development. The coal-bearing formations exposed in the region are the Bear River Frontier, Adaville, and the Evanston. The Frontier formation, the main coal-bearing unit, forms north-trending outcrop bands generally less than two miles in length.

The coal beds in the Hams Fork subregion range in rank from high volatile bituminous A in the Frontier coals, to sub-bituminous B in the Adaville formation. Thicknesses greater than 100 feet are reported for coal beds in the Adaville formation. The higher quality Frontier coals attain thicknesses as great as 20 feet. The steep dips make mining difficult in most parts of the region. Surface mineable coal resources of about 1 billion tons are reported.

DESCRIPTION OF REGIONAL ENVIRONMENTS

Coal is presently produced in several counties in this region, but is the leading mineral commodity in only three of these counties. Other important commodities include oil, gas, phosphate rock, stone, cement, vanadium, and trona (sodium carbonate). Sweetwater County, Wyoming, is the nation's principal source of trona.

Of major geological interest in the region are the Como Bluff Fossil Area and the Petrified Fish Cut, areas of dinosaur and fish fossils, respectively. The Como Bluff Fossil area is located in the northeastern section of the region, on the boundary line between Carbon and Albany Counties, Wyoming. This designated natural landmark is the site of the famous "Dinosaur Graveyard", where paleontological excavations since the 1870's have uncovered a great number of dinosaurs of various types. In the Kemmerer area of Lincoln County, Wyoming, the famous Petrified Fish Cut, was discovered when the Union Pacific Railroad cut through the shale hills west of Green River in the late 1860's. Middle Eocene fish fossils from this area are in museum collections throughout the world. Principal fossiliferous formations in the region which contain paleontological resources are the North Park, Bridges, Green River, Hanna, Ferris, Fort Chion, Lance, Lewis, Almond, Rock Springs, and Morrison.

The region has a primarily continental climate. Pacific storms pass off the south, and fronts that affect the area deposit most of their moisture on surrounding mountains. Average annual precipitation is more evenly distributed in the mountains than in the basin areas. General flooding potential is low, although flash floods do result from intense summer thunderstorms. Evaporation potential far exceeds the total precipitation usually received.

The average annual temperatures range from 37°F to 46°F, with variations due mostly to differences in elevation and exposure. Growing seasons range from 28 days at Steamboat Springs, Colorado, to 130 days at Rawlins, Wyoming.

Prevailing winds for most of the area are generally out of the southwest. Most of the harsh winter storms are out of the northwest. The wind patterns are typically funneled through some of the mountain passes and canyons. The winter winds out of the north typically bring cold dry air with velocities sometimes exceeding 40 mph. Wind directions change regularly, and tend to be less persistent in any one direction than in many other portions of the U.S. The region has surface-based inversions on 85 percent of the mornings, summer and winter. They tend to be intense, but not particularly deep.

Overall regional air quality is very good. Areas not meeting the national standard for particulates are Craig, Colorado; the trona industrial area of Sweetwater County, Wyoming; and Soda Springs, Idaho. The entire region is better than the standard for sulfur dioxide air quality.

Major drainage basins in the region are the Green and Yampa Rivers. Average annual runoff varies from less than 1 inch to over 30 inches in some of the high mountains. Many of the large streams in the area are perennial, obtaining most of their runoff from the higher mountainous areas; however, most of the tributaries originating in the lower area are intermittent. The region is vulnerable to droughts.

The quality of surface waters in the region ranges from good in the higher elevations to poor in the lower elevations.

During low-flow periods many tributary streams have over 1,000 milligrams per liter of dissolved solids. The suspended-sediment content of surface waters is generally high, and during high flows exceeds 30,000 parts per million in many tributaries.

The average annual stream flow in the Green River Basin is 5.26 million acre-feet. Fonelle and Flaming Gorge reservoirs are the largest in the region, storing about 4.3 million acre-feet. Such stored water is used to satisfy current water rights. About 2.5 million acre-feet of surface water is withdrawn per year, of which about 1.1 million acre-feet is consumptively used, primarily for irrigation.

Groundwater is found in the aquifers of alluvial deposits and bedrock strata. Alluvial deposits are good aquifers and are capable of yielding moderate amounts of groundwater. Pumping from alluvial aquifers is restricted in some States because of effects on appropriated water rights or nearby stream flow. Water in the alluvium aquifers has generally acceptable quality for most uses, but in some areas is highly mineralized.

Yields of most sandstone aquifers are low to moderate, while the highly variable limestone aquifers may yield up to 1,000 gallons per minute in wells. In general, where the aquifers are highly permeable, good quality water is obtained to depths of 1,000 feet or more. However, where the aquifers have low permeability, highly mineralized water is obtained even at shallow depths. Water quality throughout the region has not been fully explored.

The most common soils throughout this region have a sandy loam, loam, or silty surface and a calcium carbonate accumulation at depths usually greater than four feet. Permeability is moderate to low and, due to climate conditions, these soils seldom retain moisture for three consecutive months. Shallow, poorly developed soils consisting mainly of rock fragments occur along the mountains of the region. Dominant soil limitations of the region are shallowness, erosion, stoniness, and salinity.

The Green River-Hams Fork Region is part of the cold desert biome, and is comprised primarily of sagebrush or saltbush-greasewood dominated communities. Other communities of local importance include mountain shrub, evergreen, and broadleaf forest, and barren areas. Approximately 24 percent of the total regional land area is forest.

The sagebrush community is composed of a mixture of low-growing shrubs dominated by sagebrush with a variable understory of perennial grasses and forbs. Understory vegetation includes bluebunch wheatgrass, thick wheatgrass, Indian ricegrass, prairie junegrass, cheatgrass, brome, lupines, rabbitbrushes, broom snakeweed, and goldenweeds.

Where the salt content of the soil is relatively high, sagebrush dominated communities are replaced by saltbush-greasewood associations. Dominant species are Nuttall saltbush, shadscale saltbush, fourwing saltbush, and black greasewood. Associated understory includes Alkali sacaton, bottlebrush, squirreltail, and thickspike wheatgrass, in addition to many of the same understory species of the sagebrush community.

Shrub communities of the higher elevation are dominated by serviceberry-snowberry-mahogany associations with understories that include thickspike wheatgrass, prairie

DESCRIPTION OF REGIONAL ENVIRONMENTS

junegrass, bluegrasses, western yarrow, asters, and milkvetch. On well drained, poorly developed, shallow, gravelly soils, shrub woodlands, dominated by rocky mountain and Utah juniper, predominate.

Associated species include big sagebrush, low sagebrush, rabbitbrushes, mountain mahogany, prickly pear, and a variety of grasses, phloxes, and goldenweeds.

Depending upon slope, aspect, and elevation, forested mountain areas may contain associations of pinyon-juniper, spruce-Douglas fir, ponderosa pine-lodgepole, or a mixture of evergreen-aspen. Understory species include snowberries, blueberries, mountain mahogany, pine needlegrass, lupines, mountain brome, and various grasses. Broadleaf forest, consisting principally of willow and cottonwood with grass understories, are limited primarily to floodplains along perennial streams. Barren areas associated with rock outcrops have a limited vegetation cover provided by mountain mahogany, serviceberry, wild buckwheats, big sagebrush, saltbushes, and prairie junegrasses.

Primary productivity estimates for the major vegetative communities of the region range from about 1.8 tons per acre per year for sagebrush to approximately 5.4 tons per year for forested areas.

The region has 53 species of mammals including big game such as elk, mule deer, pronghorn antelope, moose, and Rocky Mountain bighorn sheep; and small game and non-game species such as whitetail jackrabbit, red squirrel, whitetailed prairie dog, longtail weasel, badger, coyote, and red fox. Twenty percent of the world's pronghorn antelope population and a major portion of the world's sage grouse population may be found within the sagebrush-grassland areas of this region. These areas also provide critical winter habitat for elk and mule deer, particularly in the northern section of the region.

Species found in the conifer-aspen forest include the Canada lynx, snowshoe rabbit, red squirrel, porcupine, and the great horned owl. The Shiras moose occurs in the conifer-aspen forest and along the willow-dominated river bottoms. Rocky Mountain bighorn sheep prefer higher elevations where the coniferous forests are broken by alpine openings.

In the woodland-bushland communities, mule deer, mountain lion, and coyote commonly occur in the woodlands during the fall, winter, and spring and range into adjacent habitats during summer. Rocky hillsides and cliffs within the woodland-bushland community provide habitat for the bobcat, rock squirrel, cliff chipmunk, desert and bushy-tailed woodrats, and pinyon mouse. Common birds of the woodland area include pinyon and scrub jay and band-tailed pigeon. Rattlesnakes, lizards, and horned toads may invade from adjacent desert areas, but are not particularly characteristic of woodland communities.

A number of game and non-game fish species are typical of the region's waterways. Principal game fish native to the region include mountain whitefish, rainbow trout, and brown trout. Fish introduced into some lakes of the region include walleye, pike, largemouth and smallmouth bass, and crappie. Non-game species found in the region include speckled dace, mountain sucker, Utah chub, redbreast, shiner, and longnose dace. Pond-marsh biotic communities are limited in extent, but have local significance. The most widespread type of aquatic or semi-aquatic situation is provided by beaver ponds

which are numerous on small mountain streams throughout the region. Also found in the pond marsh communities are mallards, pintails, teal, farrow's golden eye, Great Basin Canada goose, marsh hawk, bald eagle, and osprey.

In the region four species of fish (the Kendall warm springs darters, greenback cutthroat trout, Colorado squawfish, and humpback chub), three species of birds (the peregrine falcon, bald eagle, and whooping crane), and three species of mammals (the black-footed ferret, Utah prairie dog, and Rocky Mountain wolf) are presently officially listed as endangered species. There are no endangered plants listed for the region, although 18 species are proposed for such listing.

Wild horses are found in several parts of the region. Herds of approximately 4,500 are estimated to exist in Wyoming and in northwestern Colorado, and are estimated to increase between 15 percent and 30 percent annually.

The potential for reclamation of disturbed areas varies considerably within the region. By using the best available technology for reclamation, many of the limitations of soil and precipitation can probably be overcome. Each specific location for disturbance will require separate evaluation.

4.6.2 The Environment and Man

The earliest cultural traditions of this region were divided between big-game hunting in the eastern half of the region and gathering and hunting activities of the desert. During later periods, the entire region was under the influence of the Desert Culture, which persisted with little basic change up to the historic period. Danger Cave in Tooele County, Wyoming, is a good example of cultural persistence in this region. The cave was first occupied by Desert Culture hunter-gatherers about 9,000 B.C., and, by 4,000 B.C., articles such as rattles, gaming sticks, and clay effigies were being produced.

Astorians returning to St. Louis passed through the northern part of this region in 1812, but it was not until the mid 1820's that this area was extensively traveled. This was the era of the American fur traders, the mountain men who opened up the area of the central Rockies. Jedediah Smith in 1824 rediscovered the South Pass through the Rockies which was later used by thousands of immigrants heading for Oregon and California. By 1835 the Oregon Trail was well established and the reconnaissance work of Fremont and other Army explorers helped to map the land west of South Pass. The Union Pacific Railroad was built across southern Wyoming in 1868-1869. By 1890, one-fourth of the area was settled, and the Pony Express, the Overland Stage, and the railroad had established routes through the area.

There are approximately 50 listings from this region in the National Register of Historic Places, including stage line stations, Army forts, Oregon Trail sites, and a variety of buildings and historic districts.

Today, the region is still typically western with a low population covering vast areas of public lands and large ranches. The primary source of employment in the region is wholesale and retail trade. The construction industry accounts for 5 percent of the employment. Agricultural employment in the region is 10 percent, and mining and mineral industry in the region is 12 percent of the employment. The Government employs 23 percent of the workforce. Table 4-8 shows a

TABLE 4-8

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
GREEN RIVER-HAMS FORK REGION (a)

1975 Total Population ^a	126,938
Total Area (square miles) ^a	48,764
Population per square mile (1975)	2.6
Per Capita Personal Income (1975)	\$5,475
Per Capita Personal Income as a Percent of National Average (1975)	108

ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	3,590	7	26,118	5
Other Agriculture	1,310	3	10,863	2
Metal Mining	566	1	8,279	2
Coal Mining	1,122	2	24,324	5
Oil and Gas	3,911	8	66,201	13
Other Mining	371	1	1,994	0-1
Construction	2,616	5	50,669	10
All Manufacturing	2,001	4	18,972	4
Transportation, Communication, and Public Utilities	2,079	4	45,344	9
Wholesale and Retail Trade	10,318	21	82,464	16
Finance, Insurance, and Real Estate	1,737	4	17,179	3
Other Services	7,776	16	74,392	14
Federal Govt.	1,589	3	20,351	4
State and Local Govt.	9,771	20	69,603	13
TOTAL	48,757		516,753	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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breakdown by each economic sector for employment and earnings.

While agriculture is not large in terms of the number of people employed or the total income, it is a most visible activity throughout the region. The agricultural economy has developed in the area since the 1800's and continues to play a major role. To some extent, farming and, to a large extent, grazing of domestic livestock persist throughout the region. Farming is limited by rainfall and temperature. Cattle and sheep ranching are the leading agricultural activities.

This region has an array of recreational resources. Parts of Rocky Mountain National Park, and the Mt. Zirkal and Rawah Wilderness areas and the Denver and Rio Preservation Areas within Routt and Roosevelt National Forests, are located within the region. Five National Wildlife Refuges (National Elk Refuge, Seedshadee, Pamforth, Hutton Lake, and Arapahoe) with a combined area of approximately 37,600 acres, are also located here. The Fossil Butte National Monument in Wyoming is in the area. The Mormon, Oregon, and the Continental Divide Trails are under consideration for the National System of Trails. Three state recreational areas, three state parks, and twelve state historical sites are in the region. These facilities have a total area of over 76,200 acres and have an annual attendance of more than 693,000. Camping, fishing, and hunting are the most popular recreational activities.

Counties in the region are characterized by sparse population with densities of about 2.6 persons per square mile. The total population is approximately 126,900. The decade of the 1960's recorded high rates of out-migration ranging from 8 to 34 percent. This trend reversed, however, between 1970 and 1976 when over 33,000 persons migrated. Population and general economic data are shown on Table 4.8.

Major transportation in the Colorado section of the region is provided by the east-west Denver and Rio Grande Western railroad. The southern Wyoming region is served by Interstate 80 and by the Union Pacific railroad. There are many other paved highways and unpaved roads existing throughout the region which provide access into the major areas of economic development.

Adequate housing is in short supply, especially in the larger communities such as Craig, Colorado, and Rock Springs, Green River, and Rawlins, Wyoming. Many smaller communities within the region such as Meeker, Colorado, are experiencing housing problems. The number of mobile homes and mobile home parks have increased in many communities. Increased population in many communities has also produced increased school enrollments, resulting in overcrowded classrooms in understaffed schools.

Health care facilities are generally adequate for the region, although some areas are experiencing a shortage of physicians. Mental health care facilities, where they exist within the region, are receiving a disproportionate number of cases from energy related rapid growth. Fire protection service is generally provided by the volunteer departments, and only Rawlins, Sinclair, Rock Springs, Green River, and Evanston, Wyoming, have fire insurance ratings which are considered adequate. Expansion of water and sewer systems are of highest priority for most local officials. Nearly all water systems are publicly owned. Telephone, electricity, and

natural gas systems are generally adequate for the region, with some exceptions where local shortages may occur.

Prior to the current industrial development of both coal and trona, the region's lifestyle was primarily ranching with very little industrial development. In the last six years, rapid development of coal and trona, and expanding oil and gas exploration have brought about higher prices, more crime, housing shortages, and other boom-town characteristics which have altered and are continuing to alter this rural lifestyle.

Most of the land is Federally owned and administered by the Bureau of Land Management and the U.S. Forest Service. Within the Federal land area, some state and private lands occur. Of significant interest in the southern portion of Wyoming is the checkerboard pattern of alternating private and Federal lands interspersed with some state-owned sections.

4.7 FORT UNION COAL REGION

The Fort Union Coal Region is the largest region in the Northern Great Plains Coal Province. It encompasses 11 counties along the eastern border of Montana, 7 counties in northwestern South Dakota, and 25 counties in western North Dakota.

4.7.1 The Environment

The sedimentary rocks of the Fort Union Coal Region were deposited in the Williston basin, a sedimentary and structural depression that lies in western North Dakota and extends into Canada, Montana, and South Dakota. The combined thickness of the sedimentary rocks exceeds 15,000 feet in the deepest part of the basin southeast of the city of Williston, North Dakota. The surface formations generally dip toward the basin's center at rates of 10 to 20 feet per mile, but dips may increase to about one degree near large structures, such as the Nesson anticline. Local departures from the regional dip, especially in the coal beds, may be the result of differential compaction of the underlying sediments rather than a deep-seated earth movement.

Most of the coal is contained in the Lebo, Tongue River, and Sentinel Butte (in North Dakota), members of the Fort Union Formation of Paleocene Age. The coal beds are discontinuous and vary greatly in thickness. More than a hundred coal beds have been identified by the North Dakota State Geological Survey, but in any one section no more than three beds of commercial thickness have been found. The Fort Union formation ranges from 425 to 775 feet thick in South Dakota to 1,500 feet thick in Montana and contains an estimated 440 billion tons of lignite. The coal throughout most of the Fort Union region is lignite in rank; however, westward from the Montana-North Dakota state line, the rank of the coal increases to subbituminous C near Miles City, Montana and subbituminous B further to the west. Estimated subbituminous reserves in the aforementioned areas total approximately 33 Billion tons of surface-mineable coal.

The Fort Union Coal Region is within the glaciated and the unglaciated Missouri Plateau Sections of the Great Plains Physiographic Province, except for a small area at the northeastern boundary which is part of the Central Lowland Province. The Missouri Escarpment which is the eastern boundary of the Great Plains Province is a northeastward

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facing escarpment, commonly 200 to 300 feet high. It extends from the northeast corner of North Dakota diagonally to near the center of the south boundary and beyond into South Dakota.

The Drift Prairie Section of the Central Lowland east of the escarpment includes a large part of eastern North Dakota. Glacial deposits, such as ground moraine and outwash plains, are characteristic of the gently undulating land surface. They may be as much as 200 feet thick, but generally, the relief is 20 feet or less. In the part of the area north and east of the Missouri River, channels cut into the glacial drift by meltwater from the ice are common. They are generally 20 to 50 feet deep, and range in width from 100 feet to as much as one-half mile. Most are partly filled by glacial outwash and alluvial material. Some coincide with deep preglacial valleys.

Southwest of the Missouri River, glacial deposits are thin or absent, natural ponds are absent, and the boundary of the Glaciated Missouri Plateau is poorly defined. The maximum extent of glaciers is marked by the locations of glacial erratics. The major streams and their tributaries are in preglacial or interglacial valleys. The general character of the terrain is similar to that of the unglaciated region to the south.

The unglaciated Missouri Plateau in southwest North Dakota, northwest South Dakota, and western Montana, is a gently sloping plateau. The present surface consists of rolling prairie, isolated buttes and mesas, and badlands. It has been mostly carved since the ice age by intermittent erosion of the nearly flat-lying easily-eroded rocks at the surface.

Clinker, formed when heat from the natural burning of coal baked the overlying rocks, has been a factor in the formation and development of badland topography. The level of the surface above the burned coal bed is lowered by a number of feet equal to the thickness of the burned coal bed. The clinker strongly resists weathering and erosion, and it forms a cap-rock that adds to the irregularity and roughness of the land surface.

Badland are found along the Little Missouri River, along the lower reaches of the Powder River, and the area surrounding Fort Peck Reservoir on the Missouri River.

The Fort Union Coal Region has a semi-arid continental climate. Winters are long and cold; summers are short and warm. Considerable frontal activity passes through the area, but being distant from major sources of moisture, precipitation is not plentiful. A dozen to 15 times a year, arctic air breaks into the region, causing severe winter cold. The extreme cold is often moderated in the western and southern portions of the area by "chinook" winds that develop on the eastern slopes of the Rocky Mountains.

The mean annual temperature varies from 38°F in some locations in the northeast part of the region to 45°F in the southeast portion. This area is subject to the dominant path of arctic generated storms crossing the Canadian-U.S. border, as well as the "chinook" winds that moderate the cold temperatures in the western portion of the region.

Annual precipitation varies from slightly less than 12 inches in northeastern Montana to 16 inches in the eastern portion of the region. A few points near prominent terrain features cause slight aberrations in the otherwise smooth increase in average precipitation from west to east. Most precipitation occurs in the growing season, occurring as showers or thunderstorms. Rainfall, therefore, tends to be

spotty and local flooding may occur not far from places that are enduring drought.

Floods along the main stem of the Missouri River are generally caused by spring snow-melt and are aggravated by ice jams. Major rainstorms sufficient to cause widespread flooding are rare. Drought effects usually appear in this semi-arid region soon after the precipitation drops much below the long-term mean. The windy, sunny conditions that prevail in the area cause evaporation to exceed normal precipitation by a factor of two or more.

The region is windy; average speeds for the year are 10-12 mph. The prevailing direction is northwest, but southerly winds are common during warm months.

Surface-based inversions occur on about 65 percent of winter mornings and 80 percent of summer mornings. Forty to 50 percent are accompanied by winds of 5 mph or more. On summer afternoons, surface-based inversions are rare; on winter afternoons, they occur 25-30 percent of the time. Morning mixing depths tend to be lowest in summer in the eastern part of the region and in the winter in the western part.

The Fort Union Coal Region's air quality is very good for both particulates and sulfur dioxide. This holds true for all portions of the three states (Montana, North Dakota, and South Dakota) included in the region.

Surface water resources are very limited in the Fort Union Coal Region except for those areas adjacent to the Missouri and Yellowstone Rivers. The Little Missouri River, which runs north through the middle of the region to the Missouri, and all of the tributaries to the Missouri downstream from that point have highly variable flows.

Surface water runoff is very low (less than one inch over most of the area) and quality is poor. Total dissolved solids exceed 350 million parts per liter nearly everywhere. Hardness levels are mostly within the 180-240 mg/l range. These tributaries generally carry a sediment load in excess of 1,900 mg/l. Sediment loads have been greatly reduced in the Missouri River since it has been extensively dammed, each reservoir acting as a sediment trap.

Groundwater is available in small to moderate quantities almost everywhere, but only in large amounts locally, particularly in the alluvial valley fills along the perennial streams. The greatest potential for groundwater development in the region is from glacial outwash sands and gravels and valley alluvium, particularly along the Missouri River and, in lesser amounts, along the Yellowstone River. Groundwater may also be developed in dependable supplies from the Fort Union Formation and the deeper Fox Hills and Hills Creek Formations. Most of these deeper groundwaters are moderately mineralized at depths of less than 500 feet.

Soils in the northeastern half of the region have been derived from glaciated materials. These soils are generally loamy soils with good productivity and stability. The area northeast of the Missouri escarpment is rolling mid-tall grass prairie characterized by wheat grass, big and little Bluestem grasses, and needle grass. The remainder of the region is dominated by the mid grass and mid-short grass prairie type, except for the floodplains along the major streams and the badlands on the Little Missouri, Lower Powder and around Fort Peck Reservoir.

The mid grass prairie which covers the mid-section of the region is characterized by loamy to clayey loamy soils from

DESCRIPTION OF REGIONAL ENVIRONMENTS

east to west. Dominant plants are needle grass, wheat grass and blue stem grasses. No short grasses are dominant. The mid-short grass type is found in the extreme western portion of the region north of the Yellowstone River. These rolling prairies have loam to clay loam soils and are dominated by western wheat grass, needle-and-thread grass, and blue grama grass.

Badlands are characterized by breaks along rivers and streams with steep south facing slopes of exposed shales, sandstones, scoria, and clays. Soils are dry much of the year. Dominant plant species are arid-land shrubs and grasses associated locally with scrubby ponderosa pine forests.

The floodplains have alluvial soils with high water tables. Vegetation is predominantly hardwood trees and shrub species.

It should be noted that none of the regions are particularly fragile. With proper soil and vegetative management, all can be reclaimed to a near-original state, following surface mining.

Wildlife occurring in the Fort Union Coal Region is similar in composition to that of the Powder River Region. The various habitats support 87 species of birds, approximately 70 species of mammals, 200 species of fish, and 20 species of amphibian and reptiles, as well as numerous insects and other invertebrates.

Principal big game animals include mule deer, whitetail deer, and pronghorn antelope. While ranges may occasionally overlap, each is associated with a preferred habitat. Primary mule deer habitat is provided by the rough breaks and badlands where browse species, such as buckbrush, skunkbrush, yucca, chokecherry, and mixed grasses occur. Whitetail deer, while widespread throughout the region, prefer river bottoms and other areas where dense vegetation provides adequate cover. Preferred food items include buckbrush, chokecherry, rose, cottonwood, willow, aspen, and green ash. Prime pronghorn antelope range occurs on the rolling or broken grasslands interspersed with large sagebrush flats. Where available, big sagebrush and silver sagebrush provide critical winter browse.

Principal small game animals within the region include eastern cottontail, desert cottontail, snowshoe hare, gray squirrel, and fox squirrel.

The eastern cottontail is widely dispersed through the area, while the desert cottontail prefers shrubland habitat. Snowshoe hare, fox and gray squirrels are typically associated with woodlands.

Furbearers and other small mammals associated with this region include typical grassland species such as Richardson ground squirrel, thirteen-lined ground squirrel, blacktailed prairie dog, western harvest mouse, deer mouse, meadow vole, prairie vole, and blackfooted ferret; woodlands and shrubland species, such as gray fox, raccoon, badger, skunk, bobcat, opossum, least chipmunk, wood rat, and southern red backed vole; and wetland and semi-aquatic species, such as beaver, mink, and muskrat.

Gamebirds of the region include sharp-tailed grouse, ring-necked pheasant, Hungarian partridge, and wild turkey. Both sharp-tailed grouse and the introduced pheasant prefer large expanses of undisturbed native grasslands interspersed with brush for food, cover, and nesting. The Hungarian partridge is widely dispersed but prefers areas of limited

agriculture where shelterbelts are available for cover. Wild turkey are more limited in distribution and tend to be associated with river bottom woodlands, or around ranches and farms where they have become accustomed to human activity.

Wetlands, occurring primarily as scattered potholes along the Missouri River and other drainages within the region, are of primary value as nesting and feeding habitat for waterfowl of the Central Flyway. Breeding species include mallards, green-winged and blue-winged teal, pintail, redhead, canvasback, gadwall, American widgeon, shoveler, and wood duck. Shorebirds and other non-game birds associated with these wet areas include cranes, grebes, sandpipers, terns, and gulls.

The large areas of open terrain found throughout much of this region provide both seasonal and year round habitat for a variety of predator birds. These include golden and bald eagles, osprey, marsh hawk, sharp-shinned hawk, rough-legged hawk, Swainson's hawk, Cooper's hawk, red-tailed hawk, prairie and peregrine falcon, barn owl, long-eared and short-eared owl, burrowing owl, and great horned owl.

Open areas, woodlands, and edges are utilized by a wide variety of song birds, warblers, and woodpeckers. At least 145 species of non-game birds occur within the region, including black-billed cuckoo, belted kingfisher, red-headed and red-bellied woodpeckers, catbird, robin, eastern and mountain bluebird, yellow warbler, tree and chipping sparrow, cowbird, and cardinals. Principal species of game fish stocked in reservoirs and lakes include walleye, sauger, northern pike, white bass, yellow perch, largemouth bass, channel catfish, and black bullheads. Non-game species common to most streams and rivers include a variety of minnows, shiners, and suckers.

There are six species of endangered animals that occur or have been reported in the region. These are the northern kit fox, peregrine falcon, black-footed ferret, whooping crane, and Tule white-fronted goose. Presently there are no endangered or threatened plants in the region, although a number are proposed for inclusion in the Federal list. They may eventually be given protection under the Endangered Species Act of 1973.

4.7.2. The Environment and Man

The Fort Union Coal Region has experienced many changes in climate since the Paleo-Indian crossed a land or ice bridge from Asia to the Western Hemisphere. There is evidence that the region has a prehistory much like the Powder River Coal Region. The distinctive culture of the Fort Union Coal region was agricultural oriented along both sides of the Missouri River in North Dakota.

Agriculture in this region consists primarily of spring wheat farming in the northern and eastern portions, and cattle ranching with some irrigated crop production in the southern and western portions. Farms tend to be large, averaging over 1,000 acres in commercial wheat growing areas in the region.

Cropland constitutes over 75 percent of the total land area along the northeastern border of the region down to under 5 percent in the southern portion (Montana and South Dakota). Irrigated cropland represents less than 1 percent of the farmland over most of the region, with some counties in

DESCRIPTION OF REGIONAL ENVIRONMENTS

Montana and North Dakota having from 1-4 percent of cropland irrigated.

Principal agricultural crops grown within the region include soybean, hay, wheat, oats, and sugarbeets. Yields per acre for these crops are 17.3 bushels for soybeans, 1.4 tons for hay, 24.6 bushels for wheat, 42.1 bushels for oats, and 19.3 tons for sugarbeets. Cash-grain farms, along with livestock farms and general farms, are found in the northern and eastern portions of the region, while livestock operations predominate in the other areas of the region.

Table 4-9 shows the employment and earnings for the Fort Union Coal Region. Federal, state, and local governments employ 28 percent of the population. This is significantly higher than the national average which is 17 percent. Federal employment is 3 times greater than the national average. Agricultural employment is the second strongest sector employing 25 percent of the population. This is five times the national average. This statistic emphasizes the dependence of the regions' people on the biological productivity of the region.

The infrastructure of the region is similar to most of the rural west. Businesses that supply the needs of farmers and ranchers are located in trade centers across the region. These trade centers are small and, along with the rural population, are relatively stable. Public services in these towns are limited and not usually amenable to significant expansion. Medical facilities are limited and those in need of special care usually travel to Denver, Colorado, or Rochester, Minnesota. Bismark is the exception to the rule. It is a growing urban center that is developing many of the social and cultural services not found in the smaller towns of the region.

Due to the rural nature of the region most of the recreation is outdoor oriented. Fishing, hunting, and site-seeing are common activities. Hunting also draws people from outside the region.

4.8 SAN JUAN RIVER COAL REGION

The San Juan River Coal Region covers 57,047 square miles in the Four Corners area of the Southwest. The region occupies 16 counties in portions of New Mexico, Colorado, and Utah.

4.8.1. The Environment

This region is part of the Colorado Plateau physiographic province with high plateaus of stratified rock cut by deep canyons. Elevations generally range between 5,000 and 7,500 feet. Topographically, it is a basin with mesas, rolling plains, badlands, and canyons that are lower than the surrounding mountain ranges: the San Juan Mountains to the north, the San Pedros to the east, the Zunis to the south, and the San Francisco Peaks to the west.

The region's variety of landforms has resulted from its geology and the forces of erosion. Mesas and ridges are held up by caps of sandstone, whereas the adjacent lowlands have formed by erosion of the softer shales. The Menefee Formation, which is mostly shale, lies beneath relatively thick sandstone and forms the lowlands and valleys. Steep-walled canyons form where the resistant sandstone is thick. Badlands form in thick shale sequences imbedded with thin lenses of sandstone. The Fruitland Formation, which is composed of

shale, minor amounts of sandstone, and some coal, has been carved by water and wind into distinctive badland shapes.

The San Juan River Coal Region contains sedimentary rocks ranging in age to 500 million years. The Paleozoic formations, chiefly marine limestones, sandstones, and shales, do not crop out in the Region, although they underlie it. In places along the southern part of the region, this formation forms an aquifer capable of yielding water for irrigation, industrial, and municipal use. The Traissic and Jurassic Formations are chiefly non-marine sandstones, and claystones. The Entrada Sandstone and the Westwater Canyon Member of the Morrison Formation form important aquifers that may be utilized for coal development.

The formations of greatest interest are those of Upper Cretaceous age. In addition to containing coal, some form important aquifers, and many contain important fossil assemblages. When these formations were deposited, the shoreline of a large interior sea was moving back and forth in a general northeast to southwest direction through the region, so the deposits vary considerably in thickness and lithology. Most of the coal formed in backshore swamps along the seacoast. The Crevassee Canyon, Menefee, and Fruitland Formations are the principal coal-bearing units.

Coals within the region rank from high-volatile A to B bituminous, to discontinuous and dirty coals that are high-volatile C to B bituminous with high ash content. Most coals are sub-bituminous.

The region lies south of the major storm belt from the Pacific across the Rockies. The general climate is semi-arid, with variations resulting from elevation and topography. The Pacific fronts that trail across the region deposit most of their moisture on the mountains to the west. In the colder season, storms that develop off southern California move through the region once or twice a year and produce some precipitation, mostly on higher terrain as snow. During the summer, widely scattered showers and thunderstorms occur but coverage is spotty and erratic, often leading to drought in many areas of the region.

Annual mean temperatures vary from 48°F to 52°F. Temperatures exceeding 100°F occur throughout the region, but subzero temperatures are uncommon except in the mountains. A distinctive feature of the climate is the large variation in the daily high-low temperatures.

Annual precipitation averages less than 10 inches for most of the region, though points in northern New Mexico and southwestern Colorado receive 20 inches or more. At lower elevations, about half the precipitation falls between May and August. At higher elevations, a greater proportion is received from winter storms. Summer rainfall is mostly from intense local thunderstorms that frequently cause flash floods. Potential evaporation exceeds normal precipitation by a factor of 6 or more.

Wind direction tends to show the effect of local topography. Generally, winds are westerly during the day and easterly during the night, but terrain features complicate the wind field and cause significant deviations. For example, uneven cooling of the air results in downslope drainage of cold dense air during calm, clear nights; and the heating of valley walls and hills causes air to flow upslope and out of the valleys on calm, fair days. These terrain-induced circulations are

TABLE 4- 9

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
FORT UNION REGION (a)

1975 Total Population ^a		324,399		
Total Area (square miles) ^a		60,214		
Population per square mile (1975)		5.4		
Per Capita Personal Income (1975)		\$5,083		
Per Capita Personal Income as a Percent of National Average (1975)		100		
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	8,753	7	78,798	6
Other Agriculture	21,833	18	318,424	25
Metal Mining	-	-	-	-
Coal Mining	256	0-1	7,019	1
Oil and Gas	1,678	1	22,051	2
Other Mining	437	0-1	1,763	0-1
Construction	3,798	3	85,081	7
All Manufacturing	4,759	4	49,210	4
Transportation, Communication, and Public Utilities	4,098	3	94,538	7
Wholesale and Retail Trade	23,754	19	212,002	16
Finance, Insurance, and Real Estate	3,651	3	34,074	3
Other Services	15,964	13	147,154	11
Federal Govt.	11,741	9	129,261	10
State and Local Govt.	22,912	19	120,228	9
TOTAL	123,634		1,299,603	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

DESCRIPTION OF REGIONAL ENVIRONMENTS

common with the complex topography in all sections of the region.

Mixing heights and transport winds in the region have seasonal and diurnal variation. Generally, mixing heights are higher in the afternoon than in the morning. Seasonally, morning mixing heights are lowest during winter months, due to radiation inversions and afternoon mixing. Surface-based inversions occur 80-90 percent of the mornings throughout the year but are uncommon during afternoons. Stagnations are very prevalent. Ventilation values are highest in the spring because of the strong transport winds and lowest during the winter because of long nights, short days, snow cover, and persistent high-pressure systems. These various conditions result in a rather poor potential for pollution dispersion during certain periods of the year.

Nevertheless, for the most part, the region's air quality is considered good and better than the national standards. High winds can pick up dust which can cause or result in high particulate content in local areas for several days at a time. Areas generally not meeting the standards for particulate content include Coconino County, Arizona, and the industrial areas around the Four Corners and San Juan generating stations in San Juan County, New Mexico. Sulfur dioxide air quality is generally better than the national standards except near the generating stations about 15 miles west of Farmington, New Mexico. The region is now primarily rural except for the towns of Gallup and Farmington, New Mexico and Durango, Colorado. Most industrial, commercial, and population growth is expected to be in these urban areas. As this occurs, the air quality will probably deteriorate.

Major rivers draining the region are the San Juan, the Colorado, and the Little Colorado. The region encompasses headwaters of the San Juan, the only stream that receives flow from outside the area. Potential evapotranspiration ranges from less than 24 to about 35 inches per year. Runoff in the Little Colorado and its numerous dry washes is almost nil. Average annual stream flow for the region measured at the confluence of the San Juan and Colorado Rivers is approximately 2.6 million acre-feet. Surface reservoirs of the region store 27.1 million acre-feet.

Only in the upper reaches of the higher tributaries of the San Juan, in Colorado, is the sediment concentration low or medium. Over most of the San Juan River Coal Region the sediment concentration exceeds 1,000 milligrams per liter. Summer thunderstorms and spring snowmelt often create floods of damaging proportions that carry tremendous loads of sediment. During such high-flow periods, the suspended-sediment content of the San Juan River and many of its tributaries may exceed 50,000 parts per million. Hardness of the surface water throughout most of the region exceeds 240 mg/liter, and all three major streams average at least 1,000 mg/liter of total dissolved solids. Approximately 1 million acre-feet of surface water is withdrawn each year for consumptive use, mainly irrigation.

Groundwater in the region is generally of very poor to fair quality where it is available. Nearly all Sandstone formations in the region yield water, which is generally sufficient for livestock and domestic purposes. Wells developed in riparian deposits or in sandstone aquifers deliver 50 to 500 gallons per minute. Groundwater withdrawals for consumptive use in the region are approximately 50,000 acre-

feet per year. The heaviest groundwater pumping is in the Gallup, New Mexico, area, which is part of the Little Colorado drainage. There, pumpage to meet the demands of industry associated with coal and uranium is removing more water from the aquifers than can naturally be replaced.

In general, the San Juan River Coal Region is characterized by steep slopes covered with only sparse vegetation and a semi-arid climate with an extremely variable precipitation. Formation of top soil is slow because parent materials are predominately sandstone and shale for all soils in the region. Permeability is slow to moderate, and the soils are used primarily for grazing. Rich alluvial soils occur along the floodplains and alluvial fans, but these make up only a small percentage of the region. The major limitations of the region's soils are shallowness, salinity, and erodability.

The region contains three major vegetative communities: grassland and grassland-shrub (lower altitudes), pinyon-juniper (5,000-7,000 feet), and montane coniferous forest (above 7,000 feet). Wildlife within the region includes at least 100 species of mammals, 116 species of birds, and 28 species of amphibians. Several species are unique to this region.

Many of the grassland-shrub areas in the region have been severely overgrazed by livestock. Dominant plant species within this habitat type include green joint fir at higher elevations and rubber rabbitbrush, greasewood, and pale wolfberry along the dry washes and arroyos. Fourwing saltbush and snakeweed may be locally abundant. Typical grasses include galleta, blue grama, sand dropseed, and Indian ricegrass. Russian thistle and cheat grass are common on overgrazed areas. Much of the region is dominated by big sagebrush. Common mammals in these areas include pronghorn antelope, black-tailed jackrabbit, desert cottontail, sagebrush vole, northern grasshopper mouse, Ord's and Great Basin kangaroo rats, prairie dog, badger, coyote, and western spotted skunk. Common birds include Gambel's quail, sage grouse, mourning dove, loggerhead shrike, sage thrasher, sage sparrow, Brewer's sparrow, red-tailed hawk, ferruginous hawk, and great horned owl. Reptiles, particularly lizards and snakes, are well represented. Common species include sagebrush lizard, leopard lizard, side-blotched lizard, bullsnake, plateau whiptail, racer, and western rattlesnake. This habitat is primarily populated by rodents adapted to dry conditions.

The woodland-bushland community supports wildlife from grassland and grassland-shrub associations plus some additional species. Typical trees and shrubs include pinyon pine, juniper, big sagebrush, Utah serviceberry, oak, fourwing saltbush, antelope bitterbrush, mountain mahogany, and cliffrose. Characteristic mammals include mule deer, rock squirrel, cliff chipmunk, desert woodrat, pinyon mouse, bushy-tailed woodrat, coyote, and bobcat. Birds include the ash-throated flycatcher, scrub jay, pinyon jay, blue-gray gnatcatcher, western bluebird, and acorn woodpecker.

Typical species of coniferous forest and forest edge communities include Douglas-fir, blue spruce, Englemann spruce, aspen, and oak. Typical mammals include mule deer, elk, snowshoe rabbit, red squirrel, golden-mantled ground squirrel, deer mouse, porcupine, black bear, marten, and cougar. Birds include the mountain bluebird, varied thrush, western tanager, common raven, gray jay, blue grouse, pygmy

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owl, flammulated owl, saw-whet owl, great horned owl, and golden eagle.

Numerous plant and animal species proposed for endangered or threatened status exist in the San Juan River Coal Region. Presently, however, no plant species in the region are classified as endangered, but nine animals are: the black-footed ferret, peregrine falcon, bald eagle, river otter, Colorado River squaw fish, humpback chub, bonytail chub, humpbacked sucker, and Great Basin silver spot butterfly.

All areas within the region can probably be reclaimed after disturbance, provided that topsoil is replaced as a plant medium and adequate moisture is available for plant germination and emergence.

4.8.2 The Environment and Man

The San Juan River Coal Region is one of the most interesting historical and archaeological regions in North America. The earliest known use of the region, dating back as far as 10,000 B.C., was by mobile hunter-gatherers. This subsistence pattern continued until about two and three thousand years ago, when the Anasazi people began a more settled existence and started raising domestic plants, such as squash, corn, beans, amaranth, and chili. Large multi-storied pueblos developed, reaching a peak of elaboration at about 1,000 to 1,100 A.D. Their locations appear to have been determined primarily by the availability of water for floodwater farming and controlled irrigation. Recent evidence indicates that major pueblos were linked by a complex road network; and it is possible that the entire San Juan River Coal Region was organized into a regionwide economic and political system. During the 1300's the area along the San Juan River was abandoned for unknown reasons.

The earliest Navajo materials are found in the north-central part of the region, along the Colorado-New Mexico border. After acquiring sheep from the Spanish, the Navajos spread quickly, and by about 1800, herding and limited agriculture were dominant economic patterns throughout the region.

Spanish explorers and missionaries ventured into the northern Southwest in the 16th, 17th, and 18th Centuries, but it was not until the early 1800's that non-Indians arrived with any frequency. Trappers, miners, and travelling merchants began arriving regularly during the early to mid-1800's. During the period between 1850 and 1890, Army expeditions extensively mapped the region, restricted Indian activities, and established forts; and traders greatly increased the level of Indian contact when the Atlantic and Pacific Railroad crossed the southern portion of the region. By 1890, about one-fourth of the area was settled. At present, there are approximately 30 listings in the National Register of Historic Places for this region, many associated with Indian tribes.

The economic patterns of the region are closely related to energy development. The three economic sectors that supply the majority of jobs are commercial and professional services, wholesale and retail trade, and mining. These three sectors accounted for 75 percent of all employed workers as of 1974. Table 4-10 provides an overview of pertinent economic and demographic data for the San Juan River Coal Region.

Commercial and professional services are largely limited to the population centers. Most services are related to the oil,

gas, and mining industries. The expansion of urban areas, as distribution, transportation, and communication service centers, has been simultaneous with the growth of light industry. The expansion of government services is related to the vast holdings of Federally controlled lands within the region. Approximately 42,803 workers, or about 43 percent of the total work force is involved in services.

Mining has been important to all the states in the region. Much of the growth of the transportation, communication, and utilities sectors of the economy has stemmed from mining activity. Coal has been mined historically in all states of the region, but only recently have these reserves received national interest. Oil and gas are produced in half of the counties and are the leading commodities in one-quarter of the counties. The most common mineral produced in the region is sand and gravel, but a wide variety of metals (uranium, copper, zinc, lead, vanadium, gold, silver, and iron) and nonmetallic (crushed stone, clay, gypsum, lime, potassium salts, and salt) are also mined.

Historically, agriculture was the principal employment sector until the early 1950's, when energy-related development started to increase. With population increases, urban expansion moved to the prime agricultural valleys.

Agriculture in this area consists of irrigated farming along water courses and the grazing of cattle and sheep. Dryland farming is important locally, especially in the Colorado portion of the basin. The value of farm products sold is less than \$1 per acre of land throughout the region; most income is derived from sales of cattle and sheep. Principal agricultural crops grown within the region include corn, hay, wheat, cotton, and sugarbeets.

Relatively low population, remoteness, and breathtaking scenery combine to make recreational opportunities almost unlimited. Two rivers in Colorado, the Dolores and Los Pinos, are under consideration for inclusion in the Wild and Scenic Rivers System. There are six National Monuments in the region and twelve state recreational facilities. The most popular recreational activity in this region is camping, followed by fishing, picnicking, and hunting. Recreation is showing significant economic growth in all areas.

Land ownership throughout the region is primarily Federal. Federal lands are National Forests, and public lands (administered by BLM). Only a small percentage of the land is private. This has made urban expansion expensive and difficult.

The recent economic growth in the region has led to many problems. Attempts to quickly expand facilities and services, such as utilities, transportation, housing, and schools, have generally been inadequate. Deterioration of existing roads and other structures has resulted from overuse, while the quality of services afforded residents has been diminished by lack of trained or available personnel. Services, such as education, health care, and fire and police protection, have historically been inadequate in rural areas and are now deteriorating in growing urban areas. In many communities, schools are overcrowded and the lack of adequate housing is extreme.

The region is well supplied with energy by the Colorado River Storage Project of the Bureau of Reclamation, by municipal, private, and cooperative power companies, and by natural gas distributors. Recent growth in demand for

TABLE 4-10

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
SAN JUAN RIVER REGION (a)

1975 Total Population ^a	351,143			
Total Area (square miles) ^a	57,047			
Population per square mile (1975)	6.2			
Per Capita Personal Income (1975)	3,753			
Per Capita Personal Income as a Percent of National Average (1975)	74			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	3,957	4	23,374	3
Other Agriculture	3,805	4	17,707	2
Metal Mining	3,495	4	37,169	5
Coal Mining	283	0-1	7,478	1
Oil and Gas	3,887	4	29,205	4
Other Mining	445	0-1	2,585	0-1
Construction	4,649	5	65,362	8
All Manufacturing	6,331	6	46,679	6
Transportation, Communication, and Public Utilities	3,567	4	59,822	7
Wholesale and Retail Trade	21,551	22	136,141	17
Finance, Insurance, and Real Estate	3,344	3	28,623	4
Other Services	14,082	14	121,665	15
Federal Govt.	6,991	7	78,495	10
State and Local Govt.	21,730	22	147,222	18
TOTAL	98,117		801,527	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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electricity has been rapid. Demand for natural gas has been increasing at a lesser rate, due to rising prices. Transportation facilities are best developed in urban areas. The major transportation network within the region are highways, but neither construction nor maintenance has kept up with the expanded use. An 80-mile coal slurry pipeline, known as the Black Mesa Pipeline, transports coal from mine site to a power plant. Railways are almost non-existent.

Water may be one of the most stringent limits on future growth. Water supply and wastewater treatment require advanced technologies in what is essentially a desert environment. Few rural communities in the region possess the water supply systems and wastewater treatment facilities that are features of urban areas. Surface water is scarce; ground water often has a large quantity of minerals and salts and must be processed.

4.9 UINTA-SOUTHWESTERN UTAH COAL REGION

The Uinta-Southwestern Utah Coal Region, encompasses 56,700 square miles in part of the Uinta Basin and the Colorado Plateau physiographic provinces. The region's boundaries include twenty counties from Colorado and Utah. Six billion tons of coal reserves are estimated to be located in this region.

4.9.1 The Environment

The general area is characterized by extremes in both topography and climate. The higher peaks and plateaus rise above the adjacent lowlands which, in turn, are from about 3,000 to over 5,000 feet above sea level. Extremely steep slopes and narrow, vertically walled canyons prevail throughout much of the region. Many of the coal deposits are in the flanks of the major peaks and plateaus at intermediate elevations.

The Uinta portion of this region, the northern majority of the region in Utah and Colorado which contains the south slope of the Uinta mountains, is a structural basin with rocks on the southern flanks of the basin dipping gently toward the center. Rocks on the northern and northeastern flanks are steeply dipping with overturned beds and major faults. The remaining Southwestern Utah portion of the region includes a series of plateaus in a shallow structural basin. Many of those areas are separated by a series of major faults, including the Hurricane, Sevier, and Paunsaugunt Faults. A number of geologically significant areas within this region have been included in the National Park System as parts of Zion, Bryce Canyon, and Capitol Reef National Parks, and Cedar Breaks National Monument. A number of areas, less known to the general public but almost equally spectacular and geologically unique, have been designated by the Bureau of Land Management as outstanding natural areas. For examples, the canyons of the Escalante River and its tributaries contain numerous natural bridges and arches, towering rock monoliths, and sheer sandstone cliffs.

Principal minerals are coal, petroleum, natural gas, copper, zinc, lead, vanadium, gold, silver, and iron. Oil shale and tar sands, as well as conventional petroleum sources, are extensive.

Fossils of prehistoric plants and animals are widespread. One of the nation's major concentrations of dinosaur remains

is in the Utah portion of Dinosaur National Monument. Other deposits occur throughout the region.

Prevailing southwest winds, that move across the Colorado and Mohave Deserts, give most of the region an arid climate with a very high evapotranspiration rate. However, rugged topography and great differences in elevation and orientation cause great variations in temperature and moisture within short distances. The result is a mosaic of microclimates with significant differences between north and south facing slopes, and between sheltered canyon bottoms and exposed ridges. At higher elevations subzero winter temperatures are common. Summers are cold and growing seasons are short. The higher peaks and mountain ranges are covered with snow, often several feet deep, several months of the year.

The lower elevations are characterized by hot summers, with temperatures frequently exceeding 100°F, especially in southern portions of the region. Even at lower elevations subfreezing temperatures occur frequently in the winter.

The clear, dry air typical of much of the area is conducive to rapid temperature changes. It is not unusual to have temperatures in the eighties at midday and frost at night within the same 24-hour period.

In spite of the prevailing general movement of air from west to east many local wind variations result from the rugged topography. Warm air rises from the valley floors and plains during the day and cold air drains down from the higher elevations. Local wind flows created by these factors can be quite strong. As a rule, however, their persistence is not great.

Throughout rural portions of this region, air quality is generally very good. There are no major concentrations of particulates, sulfur dioxide, or nitrogen dioxide. Occasionally, however, air quality problems occur in the closed valleys where temperature inversions trap and hold urban and industrial emissions.

Because of the high evapotranspiration rate during summer months, winter precipitation is usually more effective in providing soil moisture and groundwater recharge.

Water from much of the region drains east and south into tributaries of the Colorado River. Principal Colorado tributaries include the Green, White, Duchesne, Price, Dirty Devil, Escalante, Paria, and Virgin Rivers. The Yampa River, though just outside the region, contributes significantly to flows of the Green. The remainder of the region, including the Provo and Sevier Rivers, is in the Great Basin hydrologic region.

Most precipitation occurs on the high mountains and plateaus. Watersheds at lower elevations contribute little to base stream flows because of low precipitation and high evapotranspiration rates. Therefore, most streams diminish rather than grow in size after leaving the mountains. This natural tendency is intensified by extensive diversions and consumptive use of water by man. The Sevier River is subjected to extremely heavy use with much of the water diverted and reused several times along its course, and is largely depleted by the time the river reaches Sevier Dry Lake.

Most streams originate in the high timbered country of the headwaters. As they descend, they accumulate sediments and salts from the highly erosive watersheds at lower elevations. This natural trend is intensified by diversion of water, primarily for irrigation. Water returning to the stream as drainage from irrigated agriculture carries an increased

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loading of salts and sediments. Tributaries originating at lower elevations are usually intermittent. Stream flows and surface water use have not been quantified for this region specifically, and flows are probably less than 6 million acre-feet per year.

Dissolved solids in streams of the region range from 120 to 350 milligrams per liter in the western base of the Wasatch Mountains, and tributaries to the Upper Strawberry, which drain the south face of the Uinta Mountains. Over the remainder of the region, total dissolved solids values are greater than 350 mg/l. In some basins total dissolved solids exceed 1800 mg/l. Sediment concentrations are variable, but are greater than 1,900 mg/l in the larger perennial rivers. Suspended sediment concentrations vary extensively throughout the region.

The region is underlain by low permeability rocks that generally yield less than 50 gallons per minute to wells. However, in some of the alluvial valley fills, particularly those containing gravels and sands, yields of several hundred gallons a minute can be obtained. The quality of bedrock water supplies is generally poor.

Over much of the region soils are poorly developed. The combination of steep slopes and semi-arid to arid climate, with highly variable precipitation, results in a naturally high rate of erosion. Wind erosion is significant in southern portions of the region. Formation of top soil is quite slow. In the geologic past, much of the region was covered by a shallow sea which contributed salts to the land. In much of the region the high evapotranspiration rate has caused further concentration of salts in many areas. Salts are generally more concentrated in soils of flat valley floors and closed basins. The more productive soils frequently occur on benches, alluvial fans and gentle slopes, where there is sufficient drainage to minimize the accumulation of salts.

In addition to soil problems inherent to the topography, climate, and geological history of the region, severe range and watershed abuse by the early settlers caused loss or degradation of much of the limited and fragile original top soil. Continued heavy grazing has limited recovery of damaged areas in many cases.

Soils of the eastern part of the region generally are sandy loam, loam, or silty loam with a calcium carbonate accumulation usually occurring at depths greater than four feet. The soils of the central portion of the region are generally steep, shallow, and poorly developed, often with many rock fragments. In the southern portion of the region, the soils are a mix of the rocky soils found in the central part of the region and soils with sandy loam to silty clay loam texture with a calcium carbonate zone at one to three feet.

Vegetation is largely a manifestation of climate and soils. Plantlife within the region forms a mosaic closely conforming to the pattern of climates caused by the rugged topography. In this arid environment, moisture is by far the most vital factor in determining what vegetation will grow in a given site. Native flora ranges from cold desert through pinyon-juniper woodland to montane coniferous forest often within a few miles. Narrow belts of streamside vegetation transect all the major vegetal communities.

Numbers and kinds of wildlife present are, in turn, determined primarily by the habitat created by existing vegetation. The great diversity of vegetation supports a corresponding diversity of wildlife including approximately 90

different mammals, 270 birds, 26 reptiles, 9 amphibians, and a great many insects and other invertebrates.

The montane forests of the higher elevations contain ponderosa and lodgepole pine, Douglas-fir, and spruce. Aspen is interspersed throughout much of the conifer forests.

Wildlife representative of the montane coniferous forests include small mammals such as snowshoe rabbit, red squirrel, flying squirrel, and porcupine; game species such as elk, black bear, mule deer; and predators such as bobcat, cougar, and marten. Moose have recently been transplanted into the region. Characteristic birds include Clark's nutcracker, grayheaded junco, mountain bluebird, mountain chickadee, hairy woodpecker, ruffed grouse, blue grouse, goshawk, great horned owl, pygmy owl, and flammulated owl. Wild turkey occur in limited areas.

The woodland-brushland, at intermediate elevations consists of juniper, pinyon pine, mountain mahogany, and oakbrush with interspersions of sagebrush and grasses.

Representative mammals of the pinyon-juniper woodland-brushland communities include rock squirrel, cliff chipmunk, desert woodrat, pinyon mouse, bobcat, bushy-tailed woodrat, mule deer, and elk. A free roaming bison herd occurs in this vegetal type on the Henry Mountains of Utah. Birds include the ash-throated flycatcher, gray flycatcher, pinyon jay, plains titmouse, western bluebird, and the black-throated gray warbler.

Vegetation of the cold desert is dominated by salt-bush and greasewood, indicating saline soil, in lower, poorly drained areas. Sagebrush with associated grasses and forbs predominate on slopes and benches that are better drained and less saline.

In cold desert communities, typical mammals are the black-tailed jack rabbit, desert cottontail, Nuttall's cottontail, desert woodrat, least chipmunk, Great Basin pocket mouse, Ord's kangaroo rat, northern grasshopper mouse, pronghorn antelope, coyote, kit fox, skunk, and desert bighorn sheep. Characteristic reptiles are the leopard lizard, sagebrush lizard, side-blotched lizard, short-horned lizard, bullsnake, plateau whiptail racer, and western rattlesnake. Birds include red-tailed hawk, Gambel's quail, sage grouse, mourning dove, great-horned owl, loggerhead shrike, sage thrasher, sage sparrow, and Brewer's sparrow.

Streamside vegetation consists mainly of cottonwood, willow, and herbaceous wetland plants. The narrow belts of riparian woodlands are vital to many wildlife species and support a greater diversity of wildlife than any other single habitat type. This is especially true in lower and more arid areas where the riparian vegetation is literally an oasis in the desert. The cottonwoods and other trees often provide the only nesting and perching sites in many miles for raptors and other birds.

Throughout the region, much of the vegetal cover has changed considerably since the coming of settlers and the grazing of domestic livestock. Prior to this time, grasslands were more extensive and sagebrush and pinyon-juniper more limited in area. Heavy grazing of grasses favored an increase in shrubs and woodland. This caused an increase in numbers of deer and a decrease in numbers of elk, antelope, and desert bighorn.

Productivity estimates for the natural vegetation within the region range from a low of 1.8 tons per acre of sagebrush,

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to 5.8 tons per acre for woodlands, and approximately 8.0 tons per acre for evergreen forest.

Reclamation of land, to the point where it supports the same vegetation and fauna that was there before disturbance, is a slow process in much of the region. In the more arid areas, the probability of seeding success is approximately one year out of three. In a drought cycle several years may pass before suitable moisture conditions occur for reseeding success. Transplanting of seedlings is sometimes required for some desirable shrub species. Trees grow slowly, and 100 years or more may be required to replace a mature stand of timber.

In some cases, predominant existing vegetation represents a deteriorated watershed condition resulting from longterm overuse by livestock and big game animals. Therefore, restoration of the exact existing vegetation might not always be desirable.

The numerous habitat areas isolated from one another by barriers of terrain and climate have encouraged the evolution of a number of unique plant species. Eighty-four plants in the region have been proposed for Federal endangered or threatened status; however, only the Rydberg milk-vetch has been designated as threatened. None are Federally considered to be endangered. The remaining 83 may not eventually receive this status.

A number of Federally listed endangered or threatened animals inhabit the region either year-round or seasonally. These include the northern bald eagle, peregrine falcon, Utah prairie dog, black-footed ferret, and whooping crane. Endangered and threatened fish include the endangered Colorado squawfish, humpback chub, and Virgin River roundfin. The Virgin River spinedace and Virgin River roundtail chub have been recommended for endangered classification. The razorback sucker is on the Federal threatened list and the Colorado endangered list. Additionally, Colorado cites the river otter as endangered and Utah cites the spotted bat as unique.

4.9.2 The Environment and Man

The prehistory of the region includes several distinct archeologically defined cultural periods: The Paleo Indians (big game hunters-12,000 B.C. to 500 B.C.), Archaic (hunter/gatherers-12,000 B.C. to 500 B.C.), Desert Anasazi (sedentary agriculturists-A.D. 700 to A.D. 1250), Paiute (hunter/gatherers A.D. 700 to A.D. 1250), Paiute (hunter/gatherers A.D. 1100 to the historic period). Numerous small groups of cliff dwellings and other archeological sites are scattered throughout canyons, mainly in southern portions of the region. Indian artifacts are scattered throughout the region. Modern Indians still occupy considerable areas.

The first documented non-Indian passage through southern Utah and western Colorado was by the Dominguez-Escalante expedition of 1776-77. The somewhat later, trade-oriented Spanish Trail also passes through the region. The region was visited in the earlier 1800's by the government explorer John C. Fremont, the famed trapper Jedediah Smith, and other trappers, fur traders, and mountain men.

Very soon after their arrival in the Salt Lake Valley in 1847, the Mormons initiated exploration and colonization missions on a substantial scale. Initial thrusts were along the western base of the Wasatch Plateau and in the Sevier River

Valley where snow fed streams from the mountains provided water for irrigation. The region was originally settled primarily for agriculture and stock raising. However, discovery of minerals soon brought about considerable mining activity in some areas. The Mormons established settlements as rapidly as possible in almost every location which the resources could conceivably support. The Colorado portion was settled in a more typical fashion. The White River Basin, somewhat isolated from the main travel routes through the mountains, was occupied by white settlers later than much of the region.

Mining of coal began in numerous locations at an early date. The coal enterprise prospered for many years supplying primarily the railroads and local domestic and industrial needs. Replacement of coal burning railroad locomotives with diesel-electric engines and conversion from coal to natural gas and fuel oil for home heating and industrial use caused a drastic decline in coal mining activity. Many mines were inactive until recently when the construction of several large coal-fired power plants created a greatly increased demand.

The uranium boom following World War II brought thousands of prospectors and miners into the more rugged and remote areas of southern Utah and western Colorado. This influx was temporary and most uranium seekers left after the market for uranium declined. Roads and jeep trails established or improved during the uranium boom have had a lasting impact by increasing accessibility to many areas.

Uranium mining and processing which have been at a low level for a number of years are beginning to accelerate in response to the increase in nuclear power plants.

Coal is produced in almost half the region's counties and is the leading value mineral in six of them. Of those counties reporting actual dollar volume of production, 60 percent had total production valued at greater than \$1 million; and 45 percent had values greater than \$10 million.

Petroleum, natural gas, and natural gas liquids were produced in half of the counties and were the leading commodities in one-quarter of the counties, including two counties that had a total mineral production of \$340 million. Although sand and gravel were the most common minerals in the region, being produced in 95 percent of the counties, production value was low, accounting for only one percent of Utah's total mineral production. A wide variety of metallic minerals were produced in the region with the most common being uranium. Other metallic minerals included copper, zinc, lead, vanadium, gold, silver, and iron. In addition to sand and gravel, the nonmetallic minerals produced in the region included crushed stone, clay, gypsum, lime, potassium salts, and salt. The demand for limestone and lime is increasing as these materials are used for dust suppression in coal mines and in wet scrubbers for emission control at power plants.

Even though much of the region is sparsely populated and rural in nature, it supports localized urban centers. Price, Richfield, Vernal, St. George and Cedar City, Utah, and Grand Junction and Montrose, Colorado, are some of the principal trade centers within the region. Page and Fredonia, Arizona, and Salt Lake City and Provo, Utah, are within the area of economic influence. Nearly all communities are dependent on Salt Lake City or Denver for some goods and services.

Total population for the Uinta-Southwestern Utah Region was approximately 406,600 in 1975, with a density of

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approximately seven persons per square mile. Forty-four thousand persons migrated into the region between 1970 and 1976. Public school enrollments totaled over 100,000 students in 1975. Table 4-11 provides an overview of pertinent demographic and socioeconomic information.

Approximately 26,400 workers, or about 19.2 percent of total regional employment, are in the service sector. Combined with 29,900 workers in the wholesale and retail trade sector and 16,700 workers in the manufacturing sector, these three sectors represent over 52 percent of total employment. Approximately 13,460 persons are employed in the agricultural sector in the region.

Livestock grazing in some form occurs over much of the region. The limited area of farm land, less than 5 percent of the land area, is largely used for production of hay and feed grains in conjunction with range livestock operations.

Pastureland represents more than 75 percent of farmlands. Over 75 percent of harvested cropland is irrigated. In some counties, as much as 20-29 percent of the total farm land and most of the irrigated land was used for the production of hay to support livestock operations.

Cultivated crops produced within the region include hay, wheat, sugarbeets, and corn. Average yields per acre for these crops are 2.5 tons for hay, 23.3 bushels for wheat, 18 tons for sugarbeets, and 96 bushels for corn.

Military and other U.S. government installations and operations in and adjacent to the region make a significant contribution to the economy. In recent years the service sector related to tourism and outdoor recreation has become important. Five national parks, five national monuments, one national recreation area, one wilderness area, one national forest primitive area, several BLM outstanding natural areas, numerous ski resorts, and river running opportunities on the Colorado River, all within or immediately adjacent to the region, draw recreationists from throughout the nation.

A significant characteristic of the region is that existing population centers are far apart and often considerable distances from the natural resources that are being developed. Also, availability of land suitable for expanded municipal and residential development is sometimes physically limited by rugged terrain or inadequate water supply.

School districts range from over 13,000 students in 34 schools at Grand Junction, Colorado, to less than 100 students and one school in some smaller rural communities.

In many communities little vacant housing is available to accommodate any substantial population increase. In towns currently experiencing rapid growth there has been a marked increase in mobile homes.

Most towns have small administrative staffs which have few resources for planning future developments. Also, land use control mechanisms to manage growth are frequently lacking.

Police and fire protection range from full time professional departments to part time services of the county sheriff's departments in the smaller communities.

Except for the few major highways most roads were designed a number of years ago to handle relatively light traffic and would require upgrading to accommodate heavy coal hauling. Some coal deposits are accessible only by primitive roads and major road construction would be required if coal were developed. Only a few active railroads exist in the region.

Interstate Highway 15 skirts the western edge of the region linking the major trade centers of Utah with Las Vegas and Los Angeles to the southwest and with Boise, Portland, and Seattle in the northwest. Interstate 70 links central Utah with Grand Junction and Denver on the east. Interstate 80, just outside the region, links the Wasatch Front population centers of Utah with the San Francisco Bay area and industrial centers of the Great Lakes and northeastern regions.

Major railroads are the Union Pacific and Denver and Rio Grande Western (D&RGW). The D&RGW begins at Ogden, Utah, passes through Salt Lake City and Provo, crosses the Wasatch Plateau and parallels US 6 to Grand Junction and Denver, Colorado. A segment of D&RGW extends southward through the region to Richfield, Utah. The Union Pacific is outside the region but indirectly links the region to other population centers of the nation.

A preponderance of the land is in public ownership. Portions of nine National forests are included in the higher, timbered portions of the region. These are the Wasatch, Uinta, Ashley, Fishlake, and Dixie National Forests in Utah and the White River, Routt, Grand Mesa, and Uncompahgre National Forests in Colorado. The Uintah-Ouray Indian Reservation is located in the Uinta Basin portion of the region. Lands at lower elevations are largely public lands administered by the Bureau of Land Management. The region also includes numerous national parks and monuments. Typically, bottom lands and gentle slopes suitable for agriculture are privately owned and the more rugged terrain is in public ownership.

4.10 DENVER - RATON MESA REGION

The Denver-Raton Mesa Region is a 13 county area in Colorado and New Mexico. All but one of the counties are located in Colorado. This region consists of two separate subregions: the Denver subregion to the north and the Raton-Mesa subregion to the South. The former is located in the Colorado Piedmont while the latter is located in the Great Plains. The entire region is estimated to contain 3.9 billion tons of demonstrated coal reserves.

4.10.1 The Environment

The Denver Basin occupies a north-south trending basin characterized by gently dipping strata to the east and by steeply dipping upturned beds along the foothills to the west. Except along the foothills where crystalline rocks outcrop, the surface rocks are sedimentary. The Laramie Formation contains coal beds of sub-bituminous B and C rank. Although these beds range up to 17 feet thick, most are thinner, lenticular, and discontinuous. A number of small mines have extracted coal from this formation, particularly in Boulder and Weld Counties, Colorado, and near Colorado Springs. In addition, the Denver Formation contains extensive beds of sub-bituminous coal in an area about 75 miles long by 25-35 miles wide. Placer gold was recovered from portions of the area in the latter part of the nineteenth century, but gold is not actively mined now. Numerous producing oil and gas wells are located in the region. Production is from the Dakota sandstone and is spread over a number of small scattered fields.

TABLE 4-11

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
UINTA-SOUTHWESTERN UTAH REGION(a)

1975 Total Population ^a	406,626			
Total Area (square miles) ^a	56,271			
Population per square mile (1975)	7.2			
Per Capita Personal Income (1975)	\$3,950			
Per Capita Personal Income as a Percent of National Average (1975)	78			
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	6,243	5	31,887	3
Other Agriculture	7,218	5	35,786	3
Metal Mining	1,893	1	13,714	1
Coal Mining	2,167	2	51,511	5
Oil and Gas	2,611	2	24,109	2
Other Mining	1,423	1	15,998	1
Construction	6,608	5	106,707	2
All Manufacturing	16,755	12	149,799	13
Transportation, Communication, and Public Utilities	4,504	3	73,969	7
Wholesale and Retail Trade	29,898	22	198,023	18
Finance, Insurance, and Real Estate	4,168	3	36,770	3
Other Services	26,397	19	190,401	17
Federal Govt.	3,559	3	40,077	4
State and Local Govt.	23,687	17	143,562	13
TOTAL	137,131		1,112,313	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

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The Raton Mesa area of this region occupies a broad trough that runs north-south from northern New Mexico into southern Colorado. This basin is also characterized by gently dipping rocks on the eastern flank and steeply dipping to overturned rocks along the flanks of the Sangre De Cristo Mountains to the west. The area contains many igneous intrusions that alter the coal beds. Coal occurs throughout the sandstones and shales of the Vermejo Formation and the conglomerate, sandstone, and shales of the Raton Formations. The coal is high-volatile A to B bituminous and of coking quality throughout most of the region, except in the Walsenburg field in the northern part. The coalbearing rocks are up to 2,400 feet thick and contain coal beds mostly 2 to 5 feet thick, but ranging up to 15 feet thick in the New Mexico section of the region. Much of the coal outcrops at the surface on hillsides and along hogbacks. Some surface mineable coal reserves are reported, but a number of major coal beds of the Vermejo Formation are buried by overburden as thick as 1,000 to 3,000 feet. Sand and gravel are extracted in all counties of the region.

The climate of the Denver-Raton Mesa Region is highland continental. It is characterized by low relative humidity, light rainfall, abundant sunshine, moderate to high wind movement, and a large daily range in temperature. Precipitation generally ranges from 13 to 18 inches a year, the greater amounts falling at the higher elevations. Precipitation is heaviest in spring and early summer and lowest in the winter months.

Prevailing storm patterns across the region are west-to-east. The storms provide little moisture to the area, however, because they have already deposited most of it on the western slopes of the Rockies. Similarly, storms from the north that bring some of the coldest weather are rarely accompanied by significant precipitation. In spring, when storms tend to develop in the panhandle of Texas and Oklahoma, moisture is deposited on the eastern slopes of the mountains and the area receives the heaviest and most general rains. These taper off to shower and thunderstorm activity in the summer period.

The mean annual temperature in the region ranges between 48° and 52° F. However, daily temperatures vary by 27°F to 39°F, indicative of the high, semi-arid nature of the area and climate.

Surface wind speeds average 9-10 miles per hour. However, winds through the vertical mixing zone are less than average for the nation as a whole. Frequent night-time surface inversions and relatively high afternoon mixing heights are prevalent features of the region. The terrain and the considerable daily range in temperature tend to create local valley-mountain circulations, so that winds are not very persistent in direction except when "chinooks" occur. There is a tendency for regular reversals of flow, a situation that is not conducive to dispersing pollutants.

In spite of these factors, overall regional air quality is quite good. However, in the more heavily populated areas along the Front Range, and particularly in the South Platte River Valley, air quality frequently fails to meet national standards. The principal cause is automobile emissions coupled with atmospheric temperature inversions. These conditions are more frequent in the fall and early winter though they may occur at any time of the year.

The region is part of three major drainage basins: the Upper Missouri, the Upper Arkansas Red, and the Western Gulf. The major rivers draining the region include the South Platte and its tributaries, and tributaries to the Arkansas River. Headwaters of these streams lie to the west in the Rocky Mountains where most of the runoff originates as winter snows. Streams originating within the region are ephemeral; any runoff in them is generally from spring and summer thunder showers. Surface-water flow in the region is about 5.4 million acre-feet per year, of which over 4.5 million acre-feet is consumptively used, primarily for irrigation and self-supplied industry.

Aquifers are found both in the alluvial deposits of the Denver and Raton Basins and in the underlying sandstones. Wells drawing from alluvium in the Denver Basin primarily supply water for irrigation and yield 400 to 2000 gallons per minute. The Foxhill Sandstone is the most notable bedrock aquifer in the Denver Basin; it lies at the base of the coal zone of the Laramie Formation. Most wells in the sandstone yield water under artesian pressure, although heavy pumping has lowered the artesian head about 600 feet in some areas. Recharge areas of this aquifer are in the foothills to the west and the Black Forest area near Colorado Springs. In the Raton Basin, the Dakota Sandstone is the principal bedrock aquifer, though water is recovered from other sandstones also. Wells into these sandstones generally yield 10 to 100 gpm, and some yield over 200 gpm.

Water quality in the perennial streams entering the region is quite good, with total dissolved solids averaging less than 100 milligrams per liter. However, ephemeral tributary streams often add water containing 1,800 mg/liter or more. Due to this and to return flows water quality deteriorates progressively downstream. For example, the South Platte contains about 1,000 mg/liter of dissolved solids where it leaves the region. Similarly, the perennial streams entering the region start with little sediment, but tributary streams, particularly during peak flows, contribute very heavy loads, with the result that, in the eastern part of the region, sediment loads may exceed 1900 mg/liter.

Groundwater quality in alluvial aquifers also tends to deteriorate downstream, increasing from 1300 mg/liter of total dissolved solids near Denver to about 1800 mg/liter near the state line. Water quality of water from the sandstone varies but generally is lightly mineralized with a high fluoride concentration and some is slightly corrosive.

Due to a shortage of available water to meet municipal, irrigation, and industrial needs of the region, extensive importation of water from western Colorado has been undertaken.

Within the Denver section of this region, the soils generally have an organic-rich surface horizon and are high in bases. These gently sloping soils usually have a thin clay accumulation in the subsurface horizon and are intermittently dry for long periods during the summer. This portion of the region is on the western edge of the prairie biome and the predominant vegetation is buffalo grass and blue grama. Associated vegetation includes yucca, western wheatgrass, needlegrass, fringed sage, and prairie globemallow. Other plants of local importance include cottonwood, willows, and fourwing saltbush along drainage systems; saltgrass on saline or alkaline soils; and prairie sand reed and plains prickly pear

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in sandy areas. Ponderosa pine is found in areas southeast of Denver generally on northerly and easterly aspects and in the Black Forest north of Colorado Springs and where the grassland grades to a coniferous forest of ponderosa pine and Douglas fir along the southwest border of the region.

The predominant soils of the Raton Mesa section have a grey to brown surface horizon with a subsurface accumulation of clay, and are medium to high in bases. These soils are usually moist but have steep slopes and many areas with rock outcrops. Soil limitations in this section include erosion, shallowness, and slope. Vegetation is primarily montane coniferous forest of ponderosa pine, Douglas-fir and Englemann spruce. Pinyon-juniper stands grading into short-grass prairie similar to that in the Denver section are found in the eastern portions of the Raton section.

Primary productivity estimates for major vegetative communities range from approximately 1.8 tons per acre for mixed grass and sagebrush to 5.4 tons per acre of pinyon-juniper, 5.9 tons for deciduous forest, 7.5 tons for prairie, and 8 tons per acre for montane evergreen forest.

A high annual turnover and production in the grasslands of the Denver section provide a food base for large variety of animals. Populations of many wild animals can fluctuate widely because of periodic droughts and severe winter storms. Riparian habitats along drainage bottoms extend the forest edge into the grasslands. This greatly increases the variety of habitat available for animals; those requiring heavy cover, shade, browse, tree nesting, etc., are able to survive within the grassland.

Except for a few remaining pronghorn antelope, the original grazing animals have been replaced by domestic livestock. Mule deer are resident where ponderosa pine is found and in the fingers of riparian habitat along stream beds. Whitetail deer are found in the South Platte River bottoms and the deer population is increasing in this section.

Animal life of the Raton-Mesa section is typical of the montane coniferous forest and forest edge habitats. Typical species include mammalian yellow-bellied marmot, golden-mantled ground squirrel, least chipmunk, red squirrel, bushy-tailed woodrat, boreal redback vole, bobcat, mule deer, elk, and porcupine. Typical birds include the western flycatcher, Clark's nutcracker, mountain chickadee, mountain bluebird and pygmy nuthatch.

There are three animal species in the region whose populations have diminished to the point that they are currently on the Federal list of endangered species: the bald eagle, peregrine falcon, and masked bobwhite. There are no plant species presently listed as threatened or endangered, although a number are under consideration.

After disturbance, most areas of the Denver-Raton Mesa Region could probably be reclaimed with low to moderate difficulty. The principal limiting factor is the uncertainty of precipitation and, in some areas, erodibility of soils.

4.10.2 The Environment And Man

Both sections of the Denver-Raton Mesa Region are associated with important Paleo Indian life. East of the Raton Mesa section is the Folsom site in Colfax County, New Mexico, the first site to be positively identified as Paleo Indian. Folsom points, a particular style of projectile point

identified with this site, were found in direct association with the remains of an extinct species of bison. North of Denver is the Lindenmeier site, in Larimer County, Colorado. Extensive excavations of this site uncovered over 20,000 artifacts, primarily stone blades and projectile points, and helped to produce a better understanding of Paleo Indian life. Cultural developments following the aforementioned Paleo Indian period included the San Jose complex of the Desert Culture in the Raton Mesa section and a transition phase between the Archaic and Desert Cultures in the Denver section. Further developments continued to divide the two sections between eastern and western cultural influences. In the period following 500 A.D., the Denver section was within the cultural sphere of the Plains Bison Hunters, and the Raton Mesa section was part of the Anasazi complex of the southwestern Farmers Tradition. The National Register of Historic Places provides cultural protection for many of these and other important archeological and historical features within the region. Within historic time, eastern Colorado and northern New Mexico were the domain of several successive Indian nations. When the white man arrived in the Denver-Raton Mesa Region, the Arapaho and Cheyenne occupied the plains north of the Arkansas River and the Kiowa and Comanche occupied the land to the south.

Although Spain was the first European nation to claim what is now the Denver-Raton Mesa Region, that nation never established any settlements there. Both soldiers and friars from the settlements near Santa Fe, New Mexico, visited the area beginning in the early 1700's. They generally followed a route over Raton Pass, the same route followed by present day Interstate 25.

Within three years of the Louisiana Purchase, General Pike visited the region on his explorations in 1806. However, it was not until after the Mexican War and the treaty of 1848 that settlement began in the Raton Mesa section. Settlers came to this area primarily from New Mexico beginning in the 1850's and 1860's. By 1850, John Fremont had passed through the Denver section on two of his expeditions, and the Santa Fe Trail had been established through the Raton Mesa section. The discovery of gold near what is now Denver in 1858 brought settlement to that area, primarily from the East. Following the Civil War, the plains Indians were removed to reservations in Oklahoma.

Railroads from Cheyenne and Kansas City both reached Denver in 1870, greatly accelerating the settlement of that part of the region. Denver is the largest city in the region and is also the "energy capital" for all of the coal producing regions of the Rocky Mountain states. Of the 110 historic sites within the region that are listed on the National Register of Historic Places, half are within the City of Denver.

Dominant economic activities in the region reflect the position of Denver as a financial, trade, and manufacturing center for the whole Rocky Mountain area, as well as a western government center. Federal, state, and local governments employ 24 percent of the work force. Wholesale and retail trade (23 percent), services (16 percent), and manufacturing (14 percent) together employ 53 percent of the workers. Table 4-12 describes the major sector socioeconomic characteristics. Agriculture employs about 2 percent and mining less than 1 percent of the workers. The total labor force, expressed as a percentage of total population, provides

TABLE 4-12

POPULATION AND ECONOMIC CHARACTERISTICS IN THE
DENVER-RATON MESA REGION (a)

1975 Total Population ^a			1,854,205	
Total Area (square miles) ^a			23,937	
Population per square mile (1975)			77.5	
Per Capita Personal Income (1975)			\$5,787	
Per Capita Personal Income as a Percent of National Average (1975)			114	
ECONOMIC SECTOR	EMPLOYMENT (in thousands)	PERCENT OF TOTAL	EARNINGS (in thousands of dollars)	PERCENT OF TOTAL
Livestock	9,632	1	126,143	1
Other Agriculture	8,944	1	109,989	1
Metal Mining	513	0-1	6,781	0-1
Coal Mining	1,177	0-1	13,373	0-1
Oil and Gas	3,498	0-1	110,420	1
Other Mining	2,722	0-1	9,179	0-1
Construction	57,000	7	770,943	8
All Manufacturing	112,279	14	1,515,820	17
Transportation, Communication, and Public Utilities	50,325	6	775,049	9
Wholesale and Retail Trade	182,872	23	1,664,036	18
Finance, Insurance, and Real Estate	44,898	6	565,795	6
Other Services	130,073	16	1,440,159	16
Federal Govt.	87,956	11	1,095,350	12
State and Local Govt.	105,194	13	876,913	10
TOTAL	797,083		9,080,220	

(a) Demographic information which is based on all counties either totally or partially within regional boundaries.

DESCRIPTION OF REGIONAL ENVIRONMENTS

an estimate of the labor force participation rate. The estimated 1975 labor force participation rate in the Denver-Raton Mesa Region was 72 percent.

Per capita income for the region in 1975 was \$5,787, some 14 percent above the national average of \$5,077. Income ranged from a low of \$3,228 in Huerfano County, Colorado to a high of \$6,858 in Denver County.

Beyond the metropolitan areas, the principal industry is agriculture. In rural counties, as high as 55 percent of the workers are employed in agriculture. Regional agricultural sales were \$908 million in 1975 with over 68 percent of that being livestock, mostly beef cattle. Agriculture of the region can be divided into three separate categories. In northern Colorado, particularly along the South Platte River, there is substantial irrigation and beef production. Principal crops include sugarbeets and grains. In this area, farm products valued at \$50-\$150 per acre are produced. South of this area there is a shortage of irrigation water, and agriculture is about equally divided between dryland wheat and livestock ranching. In this area, the value of farm products sold per acre of farm land is between \$10 and \$30. In the Raton Mesa section, cattle and sheep ranching predominate and there are few cultivated crops. The average value of farm products here is less than \$10 per acre of agricultural land.

Principal crops grown within the region include wheat, hay, corn, sugarbeets, and cotton. Yields per acre for these crops are approximately 23 bushels of wheat, 3 tons of hay, 101 bushels of corn, 19 tons of sugarbeets, and 380 pounds of cotton. Agriculture employs about 18,576 persons in the region, about half of these being in the livestock industry.

Mining is a relatively minor part of the local industry, with coal mining employing only 1/7 percent of the work force. Historically there have been a number of smaller coal mines both in Boulder and Weld County, Colorado and in the Raton Basin. Oil and gas production has been the source of greatest extracted wealth with numerous small fields throughout the area. Production of sand and gravel is the most universal of the mineral industries with activity found in every county of the region. Sand and gravel are used almost exclusively for local roads and building construction.

The Denver-Raton Mesa Region is not an area of outstanding outdoor recreation opportunities. It contains no national parks, wild and scenic rivers, or wilderness areas. The region does include eight state recreation facilities and one state park, all in Colorado. These nine areas comprise some 22,000 acres and receive about 2.7 million visits annually.

Upland bird and waterfowl hunting are important fall activities, particularly in the irrigated agricultural lands north of Denver. Similarly, deer are hunted in the forested areas of the Raton Basin. Both sections of the region are on access routes to the Rocky Mountains to the west where many people, both resident and non-resident, travel for recreational activities (hunting, fishing, skiing, hiking, jeeping, mountain

climbing, etc). The most popular recreational activities within the region are camping, fishing, and picnicking.

Because of Denver's historical role as an industrial and trade center and the nearby cities of Colorado Springs and Fort Collins, facilities in the Denver section of the region are well developed. This section is served by good highway and rail systems and a major regional airport.

The area has been one of rapid growth for the past 15 years. Net immigration to the region between 1970 and 1976 was 162,000 persons. Despite this growth, the capacity of most community facilities has kept pace and public services are generally adequate. Some shortages of classrooms are noted in rapid growth portions of the metropolitan areas, but older sections of these same areas are experiencing declining public school enrollments and are facing the prospect of closing schools.

Domestic water supplies are a critical factor in the metropolitan areas. All are dependent to one degree or another on water imported from the Western Slope of the Rocky Mountains.

To a large extent, the size and nature of community facilities are a function of population density. This is reflected in the contrast between the metropolitan areas of the region and the more rural areas. In the Raton Mesa section of the region, the smaller communities have limited capacity to deal with a population explosion.

Life styles of the Denver-Raton Mesa Region can be logically divided into three main types. First is the metropolitan life style of the Denver metropolitan area which is not unlike other large cities. Many people live in the suburbs and commute to regularly scheduled jobs in the city. The city also offers a full range of cultural activities, from museums to plays and symphony concerts to professional sports events. Because of the relative proximity of the mountains, many metropolitan residents maintain an active interest and participation in outdoor recreational pursuits. Each weekend the highways to the mountains are congested with residents traveling to favorite hiking, camping, skiing, or fishing areas.

Small towns are relatively stable communities where ranchers and merchants know their neighbors. Many cultural activities and spectator-type entertainments are lacking in these areas. Residents are generally quite independent and proud of their chosen way of life.

Between these types of life styles are the small cities such as Colorado Springs and Fort Collins. These communities are large enough to support a reasonable level of cultural and educational services, yet retain much of the small town atmosphere and attitudes, particularly among the long-time residents.

Federal land surface ownership in the region is minimal and widely scattered, amounting to only about 97,000 acres. Over half of this is in Huerfano County, Colorado.

CHAPTER 5

REGIONAL IMPACTS OF FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES

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CHAPTER 5

REGIONAL IMPACTS OF FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES

The analysis presented in this chapter describes the environmental impacts of the preferred Federal coal management program and six major alternatives described in Chapter 3. The impacts analyzed are those resulting from the varying levels of coal mining, beneficiation, transportation, conversion, and utilization connected with each coal management program alternative. These impacts include those related directly to the various phases of coal development as well as those derived from supporting activities.

The first section (5.1) of this chapter presents a general discussion of the methodologies used for the determination and analysis of impacts. The second section (5.2) describes the impacts by resource category that could occur under each of the alternatives. Section 5.3 gives a summary comparison of regional impacts of the alternatives. Detailed data used to quantify the various impacts are provided in a series of appendices at the end of this statement. Section 5.4 discusses the impacts of several issue subalternatives which could affect the structure of any Federal coal management program. These subalternatives are based on the issues summarized in Table 3-4.

5.1 IMPACT ANALYSIS METHODOLOGY

Chapter 3 of this programmatic environmental impact statement identifies seven Federal coal management program alternatives. While one alternative was labeled as "preferred," no final decisions have been made. The Department's examination of its coal management responsibilities which began in 1977 will continue during the public review period for this draft statement. Comments on this draft statement will be incorporated into a final statement expected to be made available to Federal, state, and local agencies and the public in the spring of 1979. A final Federal coal management program will not be decided until after the final statement is issued.

The factors which most influence the impacts of the coal management program alternatives are changes in regional coal production and consumption levels. These production and consumption levels are used to estimate environmental residuals, which in turn are used as a basis for the environmental analysis. Residuals are not synonymous with impacts. Rather, they characterize the changes in social, economic, and environmental resources at discrete phases of the coal cycle. Environmental impacts are estimated by assessing the influence of the residuals on selected features of the environment. Where quantification is not feasible, qualitative discussions are presented.

It should be emphasized that the programmatic nature of this impact statement precludes site-specific analyses. Such analyses will be developed in subsequent regional

environmental studies. The focus of this statement, therefore, is on the National and interregional impacts of the coal management program alternatives.

The coal cycle activities which form the basis of the residual quantifications are described in section 5.1.1. Section 5.1.2 describes the general methodological assumptions, with more specific assumptions deferred until the appropriate impact discussion to ensure appropriate textual interpretation. The methodology used to calculate environmental residuals is described in a summary form in section 5.1.3 and in more detail in Appendix H.

5.1.1 Coal Cycle Activities

The activities that form the basis for analysis of impacts are those which occur from the time the coal resource is identified until the energy in the coal is used by the consumption sector. As shown in Figure 5-1, the coal cycle consists of six major activity areas. The figure also indicates which activities were analyzed with the aid of a computer program developed expressly for this purpose and those analyzed apart from the computer program. Associated with the major activities are a number of subactivities or phases in the coal cycle. These phases represent subactivity options. The major subactivity areas and phases are described briefly below. A more detailed discussion is contained in Appendix C, which also includes other information about coal such as how it was formed, its characteristics, and how it is used to meet energy demands.

5.1.1.1 Coal Extraction. There are two major methods of extracting coal - underground mining and surface mining. Until about 1950, most underground mining was by conventional room and pillar technique. This entails mining coal in a series of rooms with the room separations serving as pillars to support the strata above. After a block, panel, or section has been mined, part of the coal in the pillars can be recovered as a retreat is made toward a main entry to the mine. Since 1950, continuous mining has become widely used. By this technique, electric-powered machines rip the coal from the working face. This technique avoids the need to provide separate entries to undercut, drill, place explosives, blast, load, and roof bolt required by the conventional underground method.

Where coalbeds are relatively flat and near the surface as in much of the West, area stripping is employed. Here, overlying material is removed in long narrow cuts and the topsoil is segregated by horizon. The overburden material is placed into parallel cuts from which the coal has been removed and the topsoil is placed on top. In the East, where the terrain is steep, surface mining is generally accomplished by contour stripping. The overlying materials are removed by

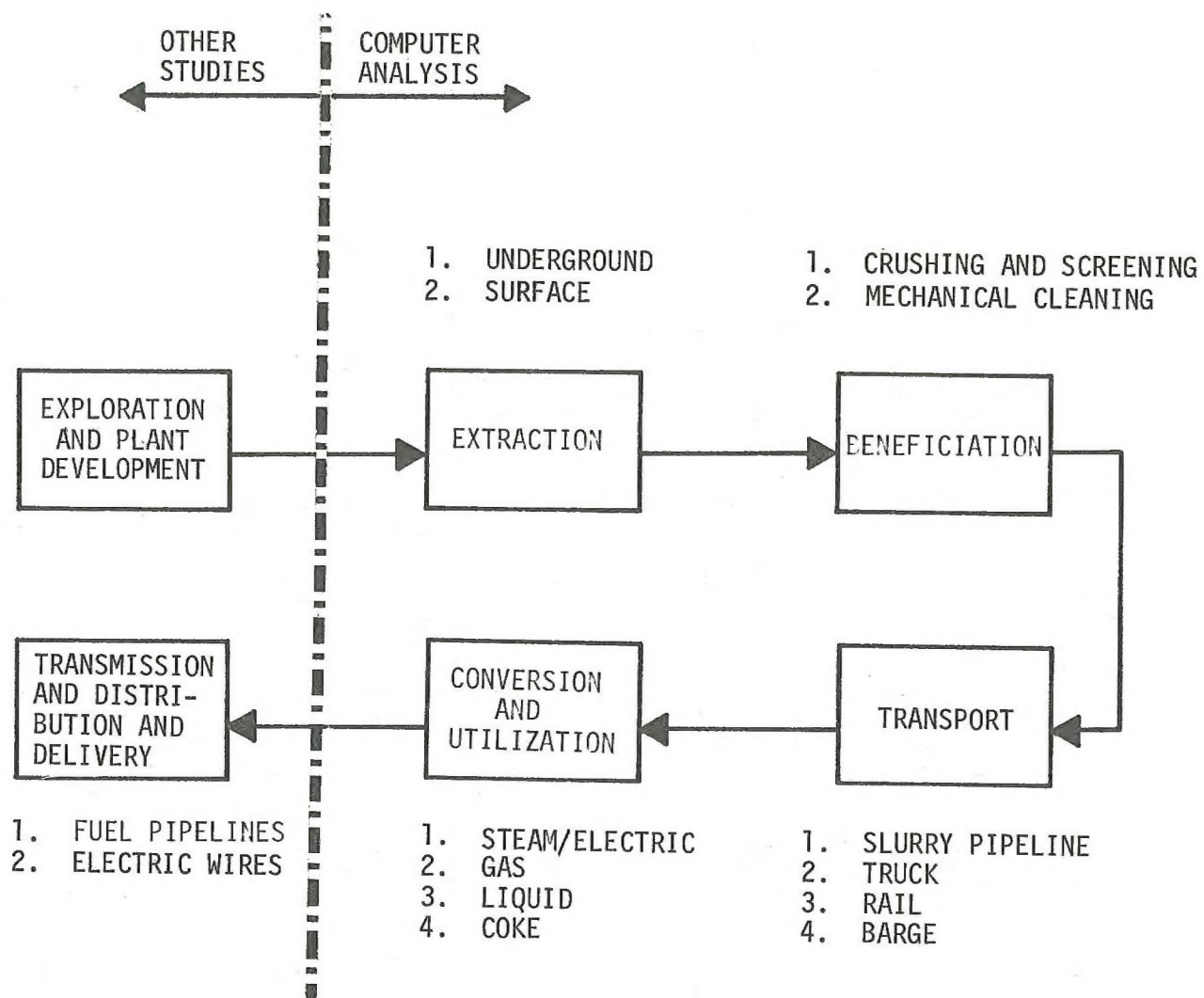


FIGURE 5-1
THE COAL CYCLE

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proceeding around the hillside, with the overburden cast down the hill. The exposed coal is then removed. This process continues until the overlying material becomes too thick to economically remove. In Appendix H, loading factors used to estimate environmental residuals generated during surface and underground mining operations for the extraction phase of the coal cycle are described.

5.1.1.2 Coal Beneficiation. Two processing options were examined in this phase of the coal cycle, crushing and screening and mechanical cleaning of coal. In the context of this analysis, crushing and screening refers to the removal of impurities such as clay, rock, shale, and pyrite. Mechanical cleaning includes operations beyond crushing and screening such as cleaning by pulsating air or by water to separate the coal and impurities [1]. Sometimes only crushing and screening is performed; sometimes both techniques are employed in tandem. Factors used to estimate impacts from crushing and screening and mechanical cleaning, and the amounts of coal to be processed by the two techniques, are discussed in Appendix H. It is noted that some coal is supplied to consuming areas without being processed, for example to plants which have their own cleaning facilities or which accept run-of-mine coal.

5.1.1.3 Coal Transportation. This phase of the coal cycle addresses the activity of conveying coal from the mine to conversion or utilization facilities (e.g., fossil fuel power plants or synthetic fuel plants). The four transport modes considered in the analysis are slurry pipeline, truck, railroad, and barge. In certain instances several transport modes are used for a given coal movement. For example, coal may be hauled from the mine area by off-road vehicles to a unit train and then to a barge loading point. As shown in Appendix H, loading factors to determine environmental residuals are developed for each type of transport.

5.1.1.4 Coal Conversion and Utilization. This part of the coal cycle includes the conversion of coal for consumptive use. In order to expand the future use of coal, it is anticipated that certain existing gas and oil consuming facilities must convert to coal, and certain new facilities would be built to convert coal into substitutes for oil and gas. The four activity options considered are use of coal as feedstock for electric power and industrial plants (steam/electric option), conversion to substitute natural gas or oil (synthetic gas or synthetic liquid option), and production of coke for industrial processes (coke option). The rationale for allocating consumption to each of these options and the development of the loading factors used to estimate environmental residuals associated with the use of coal in each option are presented in Appendix H. Appendix C contains a more detailed discussion of the processes involved in converting coal to satisfy these options.

5.1.1.5 Transmission, Distribution and Delivery. This is the final major activity in the coal cycle. It involves the delivery of the electric power and substitute natural gas and oil to a distribution center. The two phases considered are the use of electric power lines and fuel pipelines. Factors were prepared which were used to estimate the environmental residuals of constructing additional power lines to tie into an existing grid system, and additional pipelines to connect to existing

interstate and intrastate pipelines. Appendix H provides the rationale for the loading factors used in this analysis.

5.1.2 Assumptions and Analysis Guidelines

Assumptions used to establish the limits and guidelines for analysis of programmatic impacts are presented in this section. The assumptions are set forth to aid in interpreting the magnitudes of the impacts that are forecasted. They also provide a base for future regional impact analysis forecasts.

5.1.2.1 Assumptions. The assumptions used in this analysis are as follows:

- The demand for coal will encourage additional development of coal reserves.
- The amount of coal energy on a Btu basis required by coal consuming states in 1985 and 1990 is based on the Department of Energy's National Coal Model (NCM)(see Section 5.1.3 and Appendix H) demand assumptions.
- Coal mining and preparation technologies will not change significantly by 1990.
- Conversion of coal to synthetic gas and oil will be a commercial reality by 1985, but on a limited scale. Conversion on a large scale basis is not expected until after the year 2000.
- Labor, equipment, and capital shortages will not significantly distort the projected levels or timing of the Federal coal management program.
- No extensive delays will be encountered in obtaining required Federal, state, and local clearances for the Federal coal management program.
- Reclamation technology will not change significantly by 1990 and the major thrust of reclamation would be to return disturbed land to the contour and use specified in the approved reclamation plan.
- Current best practicable pollution control technology will be used to minimize the emission of air pollutants by 1985.
- Current best available control technology will be used to minimize the release of water pollutants by 1985.
- Development of other resources in the Federal coal regions will not significantly interfere with coal development under the Federal coal management program.
- The coal energy demand projected by the Department of Energy for 1985 and 1990 for high, medium, and low production levels will be met for all Federal coal management program alternatives. Production adjustments in certain western regions in response to alternative leasing strategies would be made up by compensating adjustments in the other producing regions.

5.1.2.2 Analysis Guidelines. The following guidelines were used in the analysis of impacts:

- There are twelve basic coal supply regions. For analysis purposes, the Appalachian Coal Region has been divided into three subregions—Northern, Central, and Southern.
- Programmatic impacts for these twelve regions are analyzed for two points in time, 1985 and 1990.

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- The impacts associated with the no new leasing program alternative closely approximate those of a no-action program alternative.
- The high and low coal production estimates associated with the preferred and no new leasing coal management program alternatives adequately include the possible ranges in coal levels to be achieved in the 1985 and 1990 time periods.

5.1.3 Impact Estimation

The impact estimation performed in this programmatic statement for the several Federal coal management program alternatives is based to the maximum extent possible on quantification of environmental changes and on environmental residuals which would result from the operation of the various phases of the coal cycle. In addition, the effects of related developments are quantified, where possible.

By necessity, some impacts can only be stated in general terms either because of: (1) the absence of knowledge of the exact locations where coal mining and other activities would occur; (2) the lack of adequate methods to perform quantification; and (3) the absence of consistent regional base line information which can be applied uniformly among the twelve coal regions analyzed. A detailed accounting of pollutant-related impacts upon specific air sheds or water bodies falls within the first class. Quantification of aesthetic impacts or changes in ecological community composition and diversity are examples of the second class of impacts which may only be projected in a general way.

In order to provide information on the anticipated impacts of a Federal coal management program, several analytical tools have been employed. Output from the Department of Energy's National Coal Model (NCM) has been used as the departure point for determining the levels of activity in the various phases of the coal cycle [2]. This model is described in Appendix H.

An allocation methodology (i.e., algorithm) has been employed to adjust the National Coal Model (NCM) output for use in the present analysis. This algorithm: (1) translates the 30 NCM coal production areas and 35 consumption areas to the 41 production areas and 53 consumption areas used in this environmental impact statement; and (2) estimates interregional flows from the 41 production areas to the 53 consumption areas.

The third analytical tool employed in the impact analysis is a computerized program developed for this statement, the Coal Impact Estimation Program (CIEP). This program is summarized below and a detailed description of the procedures employed are presented in Appendix H together with the program's basic inputs (coal production levels, coal transportation flows, coal consumption points and quantities, and environmental loading factors).

5.1.3.1 Derivation of Coal Production and Consumption Levels and Coal Flows. On June 1978, the Department of Energy (DOE) provided the Department of the Interior with the results from the National Coal Model (NCM) for low, medium, and high levels of coal production in 1985 and in 1990. These computer runs are starting points for the analysis of the seven alternative Federal coal management programs.

The NCM uses a least economic cost methodology to estimate the level of coal production by surface and underground methods within 30 geographic areas. It further allocates this production using the most economic transport routes to 35 geographic consuming areas by type of end use. The primary model outputs are the production and consumption levels in each region and a 30 by 35 origin/destination coal flow matrix.

Since the NCM runs address different geographic coal production and consumption areas than used in this programmatic statement, it was necessary to translate the NCM outputs into the 41 production areas and 53 consuming areas included in this environmental impact statement. In performing this disaggregation, it was assumed that the proportionality of surface and underground mining would generally remain the same, that the split between crushing and screening and mechanical beneficiation would not vary, and that the distribution among end uses of the coal would be a function of the coal energy demand assumptions included in the NCM. The translation and disaggregation was manually and judgmentally performed for each of the six DOE projections. The results of this effort are six separate 41 by 53 origin/destination coal flow matrices together with modified production and consumption levels.

Given the supply, demand, and flow data on a 41 by 53 matrix basis, it was necessary to determine what differences would exist for each of the Federal coal management program alternatives: no new Federal leasing, the preferred program, processing of PRLAs only, emergency short-term leasing, lease to satisfy industry indication of needs, and state determination of leasing levels.

The low, medium, and high western regional coal production levels for each alternative management program for 1985 and 1990 were derived from the low, medium, and high 1985 and 1990 DOE production projections and a number of other sources of information. In the absence of an established procedure for estimating these regional production levels, decisions have been made based on the information available, including:

- DOE projections.
- Department of the Interior regional environmental impact statements on expansion of existing coal mines and development of proposed new coal mines.
- Coal industry and government forecasts.
- Expected production from approved and pending mine plans.
- Likely production from Federal leases without mine plans.
- Current coal production levels.
- Contractually obligated coal production.
- Coal lands ownership patterns.
- Indian coal ownership.
- Non-Federal coal ownership.

As an example of the judgmental considerations included in this adjustment process, projected production under the no new Federal leasing alternative took into account the amount of coal already available in existing Federal leases and the production potential of these leases. Many existing Federal leases are not expected to be in production by 1985 because of small size, environmental problems, high mining costs, poor quality coal, poor location, or other factors. If not producing

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by 1986, it was assumed that leases would be cancelled for failure to be diligently developed.

Another important consideration used in estimating the impact of a no new Federal leasing policy is the availability and production potential of non-Federal reserves in a given region. In many instances, non-Federal reserves would not be developed if complementary Federal reserves are not available. Significant portions of the reserves in the western coal regions are contained in checkerboard lands or in scattered blocks where the non-Federal coal holdings are often too small to form mines of economically efficient size.

Special computer runs which used the Department of Energy's National Coal Model (NCM) were made for the no or restricted leasing alternatives. These runs were made by modifying the supply curves used in the NCM to correspond to the estimated reduced regional coal supplies that would be available under these alternatives. Federal coal not in existing leases and non-Federal coal which requires new leasing of complementary Federal coal to be developed were eliminated from the supply considered available for regional coal development. The Department of Energy's National Coal Model (NCM) was then rerun with this restricted coal supply in order to estimate the impacts on coal production by coal region.

One result obtained from the computer runs is that a number of western coal regions would show increases in coal production as a result of a no new Federal leasing policy. These regions already have major supplies of non-Federal coal or coal in existing Federal leases. Hence, when coal production is reduced in other western regions that are more dependent on new Federal leasing to sustain or increase production, some of the loss is displaced to western regions less dependent on new Federal leasing. In particular, the region in which achieving projected production levels is most dependent on new Federal leasing is the Powder River Coal Region in Wyoming and Montana. This region tends to lose production relative to projected levels while other western regions tend to gain production when Federal coal availability is tightly restricted. Production under a no new leasing policy also tends to be displaced to midwestern and eastern regions that have little Federal coal.

There are large reserves of Indian coal in the West. These reserves appear large enough that, were they to be rapidly developed, they could make up for virtually all production deficiencies caused by a no new leasing policy. However, there are many uncertainties relating to development of tribal coal reserves. For example, in Montana, the Cheyenne Indian Tribe has resisted expanded coal development and the Crow Indian Tribe recently cancelled existing coal leases in part on the basis of inadequate royalties. In estimating regional coal production levels for this environmental impact statement, it is assumed that there would not be a large expansion in the near term of Indian coal production to make up for production declines caused by a Federal decision not to lease additional Federal coal until at least 1985. However, already planned production from mines on Indian lands is considered part of the available coal supply under a no new leasing policy.

An additional factor complicating projections for the no new leasing and other Federal coal management program alternatives is the extent to which existing operations could or

would expand capacity in response to unsatisfied demands. While it is assumed that this would happen to some extent, the resulting additional production is not specifically quantified.

The distribution of western coal production under each program alternative was determined by the above process. An origin/destination matrix for each alternative was developed. The coal demand in each consuming region was specified by DOE for its runs on a Btu basis for the low, medium, and high DOE production projections for 1985 and 1990. The DOE production projections in each western region are similarly analyzed on a Btu basis, which then allows calculation of the flows in the origin/destination matrix.

Next, for each alternative, a comparison was made between the Btus of energy produced in each region and that required to meet the DOE established consumption projection for each consuming region. Where differences existed, coal flows in terms of Btus of energy delivered were modified such that the net flow of coal-derived energy into each consumption region was held constant. After a supply-demand Btu equilibrium was again attained, the Btu production and consumption levels and Btu flows were converted back to coal tonnages. The result of this procedure was the generation of new coal flow origin/destination matrices for each alternative.

The last remaining task prior to the calculation of environmental residuals for each alternative was a split of coal flows by transport mode from each origin (production area) through intermediate transshipment or transfer points to each destination (consumption area). Assumptions were made that the majority of interstate coal movements would be by rail; a smaller volume of intrastate shipments would be transported by rail; and the remainder of the intrastate movements would move by barge, highway or slurry pipeline depending on existing and projected transportation facilities of these types.

Due to the dynamic nature of coal transportation, incorporation of the transportation sector in the analysis required a methodological approach which recognizes the inherent differences between static processes and dynamic flows. In contrast to the other phases of the coal cycle (i.e., production and consumption), the characterization of coal flows in terms of tonnage does not result in a clear presentation of environmental residuals. The measure chosen to determine transportation environmental impact residuals was gross ton-miles generated as a result of transporting coal. In this context, gross ton-miles consists of the following components:

- Net ton-miles – weight of coal times distance moved.
- Tare ton-miles – weight of transportation equipment utilized times round trip distance from mine to destination and return.

The inclusion of tare, weight gave recognition to the fact that trains, trucks, and barges which haul coal also generate environmental residuals during the return trip to the coal mine or loading facility.

For each alternative and production level, the methodology developed to estimate the level of gross ton-miles generated consisted of:

- Development of the origin/destination matrices for the gross tonnages of coal flows from producing regions to consuming regions.

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- Identification of probable routes and length of route within each state between origin and destination.
- Calculation of the number of trips and coal tonnage flows within each state.
- Combination of volume of coal flow, distance, and transport mode to estimate gross ton-mileage generated per state and per region.

All of the above information formed the basis for estimation of environmental residuals generated by the several coal management program alternatives. The residuals were enumerated through the use of another computerized procedure developed specially for this programmatic environmental impact statement. The outputs of this program, the Coal Impact Estimation Program (CIEP), were employed to determine the potential environmental impacts described later in this chapter.

5.1.3.2 Overview of the Coal Impact Estimation Program. The CIEP is designed to be highly flexible and reactive to the coal management alternatives for which impact estimates are required. As presently contemplated, it could be a major component of the Federal coal management program, and would employ specific levels of coal production and consumption in separate geographic areas. These levels are combined with the distributions of coal flowing into each major phase of the coal cycle and the results are multiplied by loading factors which correspond to environmental residuals per 100,000 tons of coal or billion gross ton-miles. The residuals treated in the CIEP are presented in Table 5-1.

An overview of the major modules within the CIEP is presented in the following sections. A more detailed description of the CIEP assumptions and structure is presented in Appendix H. The CIEP consists of the three major modules described below.

Main Impact Estimation Module. The Main Impact Estimation Module uses coal production and consumption estimates for each region of the country to produce numerical estimates of the resulting major environmental residuals. This is done by expressing coal production and consumption levels as flows through the coal cycle. Once quantities of coal flowing into each phase of the coal cycle are determined for each geographic area, the environmental loading factors are applied to produce the following residual estimates:

- Air pollution – total suspended particulates (TSP), hydrocarbons (HC), carbon monoxide (CO), sulfur oxides (SO_x), and nitrogen oxides (NO_x).
- Water use – makeup (effluent and evaporative loss).
- Acreage disturbed.
- Operational and construction employment.
- Solid wastes – active and inert.
- Fatalities.
- Operating energy.

Estimates of the level of change of residual generation in each category for each geographic area and phase of the coal cycle are produced in this module. These estimates are used as input into the socioeconomic and ecological impact estimation modules of the CIEP.

Socioeconomic and Ecologic Impact Estimation Modules. There are two major subroutines in the CIEP. The first makes use of estimates of the requirements for construction and

operational workers at each phase of the coal cycle to produce estimates of total population, infrastructure demands, and fiscal requirements on a regional basis. The second uses the acreage disturbed throughout the coal cycle, on both a long and short term basis, to produce estimates of agricultural productivity losses and decreases in wildlife habitat and total carrying capacity. Both subroutines produce impact residual estimates on a phase-by-phase basis for the production, transportation, and consumption elements of the coal cycle. This feature identifies the estimated impact effects of mining and beneficiation, of transportation, and of consumption of coal by geographic area.

5.1.3.3 Coal Impact Estimation Program Inputs. The five major classes of input information required to operate the CIEP are

- Production levels,
- Transportation levels,
- Consumption levels,
- Coal cycle flow distribution, and
- Environmental loading factors.

The first four inputs have been described in the foregoing sections. They are discussed in greater detail in Appendix H. The remaining input is presented below.

Environmental Loading Factors. Environmental loading factors are used to identify and quantify the social, economic, and environmental residuals of coal extraction, beneficiation, transportation, conversion, and utilization. These loading factors relate specific impacts to a 100,000 ton unit of coal. This approach is used in all coal cycle stages with the exception of transportation. In the transportation sector, residuals are estimated per billion gross ton-miles. By generally expressing all impacts in terms of tons of coal, residual estimates are made once coal production and consumption levels are determined. Even though some states would have no coal production, they would have transportation, conversion, and utilization flows resulting in residuals. Loading factors used as input to the main portion of the Coal Impact Estimation Program are defined for the major residual categories shown in Table 5-1. These loading factors vary for the 41 producing regions, overlain with 53 consuming regions. Additional multipliers are used for a broad range of social, economic, and environmental parameters incorporated into the subroutines of the CIEP.

5.1.3.4 Program Output. The CIEP produces estimates of impact residuals that can be structured according to analytical needs. The output reports can be presented geographically, by residual category, or by phase of the coal cycle.

The program has the capability of accumulating impact residual estimates for several distinct geographic areas, and aggregating and displaying the results on a regional basis. Examples of this capability include the aggregation of the separate portions of Colorado in the Green River-Hams Fork, Denver-Raton Mesa, San Juan River and Uinta-Southwestern Utah Coal Regions into estimates for the State of Colorado. The program also produces aggregate estimates for a total coal region e.g., the Powder River Coal Region made up of the Powder River, Montana, and Powder River, Wyoming geographic areas. An additional report generated by the CIEP presents the level of coal flows into each phase of the coal cycle.

TABLE 5-1

COAL IMPACT ESTIMATION PROGRAM

PROGRAM MODULE	RESIDUAL DESCRIPTION
Main Impact Estimation Module	Air Emissions: Total suspended particulates Hydrocarbons Carbon dioxide Sulfur oxides Nitrogen oxides as SO ₂ Water Use: Makeup (effluent and evaporative loss) Land Disturbed: Short term Long term Solid Wastes: Active (scrubber waste, treatment residuals, etc.) Inert (ash, slag, rock, etc.) Accidents Fatalities Operating Energy Direct Construction Employment Direct Operational Employment
Socioeconomic Impact Estimation Module	Indirect Construction Employment Indirect Operational Employment Dependents Total Population School Age Children Teachers Classrooms Physicians Hospital Beds Housing Units Water Treatment Sewage Treatment Solid Wastes Policemen Firemen
Ecological Impact Estimation Module	Land Disturbed: Cropland Pasture Range Forest Wetlands

TABLE 5-1
(Concluded)

COAL IMPACT ESTIMATION PROGRAM

PROGRAM MODULE	RESIDUAL DESCRIPTION
Ecological Impact Estimation Module (Continued)	Productivity Lost: Corn Soybeans Cotton Wheat Sugar beets Oats Hay Grass Timber Marshland Animal units
	Biota Disturbed: Mule deer Antelope Moose Elk Deer Small mammals Song birds Game birds Predators Reptiles

REGIONAL IMPACTS

There are other features of the CIEP which incorporate additional dimensions in the output reports. In the CIEP, there are two analytical capabilities which substantially increase the flexibility of the residual estimation model. The first feature allows estimates of residual levels accompanying various program alternatives to be compared against a common baseline at a given point in time. The program output, when this feature is selected, represents the difference between the levels of residuals generated by the two alternatives. Program reports based on this output can be used for a rapid comparison of the broad effects of the alternatives in question. The second feature of the program is that it produces estimates of the change in environmental residuals for a specific program alternative between two points in time. The program is currently structured to produce differential residual estimates for the periods 1976-85 and 1985-90.

5.1.4 Other Impacts

The variability of potential impacts associated with certain resource categories precludes analysis in these areas on a quantitative basis. Owing to the site-specific nature of the elements that influence the degree of impacts on these resources, impacts at the programmatic level can only be described in general for each of the various activity sectors of coal development. The resource categories in this case include topography, geology, minerals, soils, archaeological and historical resources, and recreation. In addition, several resource impact categories can only be described generically.

5.2 PROGRAM IMPACTS

This section discusses the impacts that could result from implementation of the various alternatives for a Federal coal management program. To provide a proper perspective of the impact discussions that follow, coal production and consumption aspects of the Federal program are first addressed. The shifts in coal production amongst the regions as a result of the various program alternatives are examined in detail. This introductory material is then followed by detailed analyses of impacts. Impact categories addressed are: physical, ecological, socioeconomic, transportation system and operating energy requirements. Each impact category is discussed fully by subsection across regions and program alternatives. Although impacts may at times appear as though they were independent, they are usually interdependent. For example, land disturbance impacts cause habitat loss, productivity loss, agricultural impacts, and other physical impacts. In the same manner, population impacts might lead to employment, health and safety, recreation, and fiscal impacts.

Impacts are analyzed for two program time frames, 1985 and 1990, and are related to a base year, typically 1976. A medium projection of coal production is examined for each of the seven program alternatives considered; two of these, the no new leasing alternative and the preferred program, are also examined in terms of high and low coal production projections as well as the medium production projection. The no new leasing alternative represents the "no-action" alternative and the other six program alternatives are compared to it. In this regard, it must be emphasized that the impacts attributable to the Federal coal management program

would be only a small fraction of those resulting from meeting national coal requirements. Finally, except in the discussion of water impacts, impacts attributable to normal economic growth projections are not addressed. Growth would normally occur in the 12 regions considered due to non coal-related developments but such growth has not been considered in this impact statement.

5.2.1 Coal Production and Consumption

This section presents an overview of the broad interregional shifts in coal production and consumption associated with the Federal coal management program alternatives. Much of the discussion is based on the analysis of the role and need for Federal and western coal presented in Chapter 2 and the description of the impact methodology in section 5.1.3 of this chapter. This section concludes with a discussion of the implications of the methodological approach employed for this programmatic environmental impact statement.

5.2.1.1 Regional Coal Considerations. Summary coal production and consumption data are presented in Tables 5-2 and 5-3. For comparative purposes, Table 5-4 presents the projected changes in regional coal production from the no new leasing alternative which would result under the other coal management program alternatives. While data are presented for the high, medium, and low production projections for the preferred and no new leasing alternatives, only the medium production levels for all program alternatives are addressed in the text.

Under the no new leasing base case, the supply of Federal coal available for development would be limited to coal already under lease or coal which may be leased under the consent agreement in *NRDC v. Hughes*. This could nevertheless result in a significant increase in Federal coal production, as already existing leases alone now have a 1985 planned production of 308.6 million tons (see Table 2-20). Adding in other likely production (see Table 2-21), total planned and likely production from existing Federal leases in 1985 is 366 million tons. With the addition of planned production from Indian and other non-Federal lands, total 1985 planned and likely production in the western states comes to 422.2 million tons (see Table 2-29). Essentially none of this production depends on new leasing. In 1985, western coal production under the no new leasing alternative would be 34 percent of total U.S. production (compared to 16 percent in 1976). With the exception of the lease to meet industry needs alternative, 1985 western coal production would not vary significantly compared to other alternatives selected.

By 1990, however, the western production projections would show more pronounced changes among the alternatives. For example, western production under the no new leasing alternative would be 38 percent of U.S. production, compared to 43 percent under the preferred program, 49 percent under the lease to meet industry needs alternative, and 34 percent under the state determination of leasing levels. Within the western regions, the greatest fluctuations in absolute terms would be experienced within the Powder River Coal Region. The lease to meet industry needs and lease to meet DOE production goals alternatives project 1990 production from this region at 450 million tons and 396

TABLE 5-2

COAL PRODUCTION SUMMARY^(a)
(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	176.0	208.3	211.7	217.5	208.4	211.6	216.7	211.8	211.7	210.4	211.5	211.1
Central Appalachian	206.8	202.7	205.5	178.8	202.7	204.4	175.9	205.6	204.8	192.5	203.4	211.0
Southern Appalachian	23.4	18.0	27.5	42.7	18.0	26.6	40.6	26.5	27.5	31.6	22.1	23.0
Eastern Interior	136.4	209.0	206.1	172.4	209.0	209.7	161.0	206.0	207.1	196.1	203.4	212.6
Western Interior	11.5	12.7	14.2	14.2	12.6	13.6	14.5	13.7	14.2	8.2	10.8	15.8
Texas	14.1	62.4	64.0	48.6	62.5	66.3	35.3	63.7	64.6	50.2	57.7	78.6
Other East	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
TOTAL EAST	568.2	713.1	729.0	674.2	713.2	732.2	644.0	727.3	729.9	689.0	708.9	752.1
Powder River	37.4	150.0	204.8	275.0	150.0	205.0	300.0	205.0	205.0	225.0	204.6	183.7
Green River-Hams Fork	25.7	40.0	76.0	99.6	40.0	80.0	130.0	77.9	77.0	112.0	112.0	57.5
Fort Union	11.4	16.9	31.9	51.9	16.9	31.9	51.9	31.9	31.9	36.9	21.9	37.4
San Juan River	8.8	15.0	24.8	39.7	15.0	25.0	40.0	24.8	24.8	30.0	22.1	32.0
Uinta-Southwestern Utah	10.2	15.0	29.6	44.5	15.0	30.0	45.0	30.0	29.7	35.0	26.4	29.4
Denver-Raton Mesa	1.9	2.0	5.0	10.0	2.0	5.0	10.0	5.0	5.0	6.0	6.0	7.0
Other West	10.4	18.3	4.2	6.7	18.3	3.0	6.7	3.8	3.8	6.8	6.6	1.8
TOTAL WEST	105.8	257.2	376.3	527.4	257.2	379.9	583.6	378.4	377.2	451.7	399.6	348.8
TOTAL U.S.	674.0	970.4	1,105.3	1,201.6	970.4	1,112.1	1,227.6	1,105.7	1,107.1	1,140.7	1,108.5	1,100.9

TABLE 5-2 (Concluded)

COAL PRODUCTION SUMMARY
(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLAs ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1990 PROJECTIONS										
Northern Appalachian	176.0	193.8	219.4	261.5	193.8	220.1	252.8	219.4	219.6	217.8	222.3	225.3
Central Appalachian	206.8	191.3	211.2	237.8	191.2	206.2	217.6	210.5	210.0	203.0	205.5	225.4
Southern Appalachian	23.4	15.6	26.4	42.8	15.6	25.4	40.4	26.3	26.4	30.4	14.5	14.2
Eastern Interior	136.4	275.7	331.5	351.1	274.7	319.7	280.1	314.4	328.0	284.6	312.5	381.1
Western Interior	11.5	13.1	25.5	58.5	12.7	17.1	14.0	19.3	24.2	10.2	10.1	35.0
Texas	14.1	74.0	119.4	154.0	73.0	86.1	100.0	116.4	115.8	58.9	79.6	111.0
Other East	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL EAST	568.2	763.5	933.4	1105.7	761.0	874.6	904.9	906.3	924.0	804.9	844.5	992.0
Powder River	37.4	175.0	305.0	335.0	175.0	400.0	600.0	355.0	316.0	450.0	396.1	269.1
Green River-Hams Fork	25.7	66.5	98.7	119.0	70.0	120.0	175.0	101.0	104.2	150.0	149.5	62.8
Fort Union	11.4	21.9	51.0	94.9	21.9	41.9	81.9	47.4	50.6	51.9	22.5	54.4
San Juan River	8.8	25.0	59.4	77.3	25.0	50.0	75.0	54.9	58.4	60.0	57.7	63.0
Uinta-Southwestern Utah	10.2	19.8	45.0	65.0	20.0	40.0	60.0	42.0	44.8	50.0	28.3	36.8
Denver-Raton Mesa	1.9	5.0	10.7	15.0	5.0	10.0	15.0	10.5	10.6	10.0	7.5	10.3
Other West	10.4	14.4	10.3	7.7	14.4	10.7	9.1	8.6	10.2	3.7	8.3	14.1
TOTAL WEST	105.8	327.6	580.1	713.9	331.3	672.6	1016.0	619.4	594.8	775.6	669.9	510.5
TOTAL UNITED STATES	674.0	1091.1	1513.5	1819.6	1092.3	1547.2	1920.9	1525.7	1518.8	1580.5	1514.4	1502.5

TABLE 5-3

COAL CONSUMPTION SUMMARY
(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	163.0	180.3	182.9	180.4	180.3	182.9	180.0	173.9	173.9	173.9	182.9	173.9
Central Appalachian	50.7	49.1	56.4	56.8	49.1	56.0	56.0	56.1	56.1	56.0	56.2	56.0
Southern Appalachian	46.6	80.5	106.0	105.3	80.5	103.9	105.9	104.6	104.3	104.0	102.6	104.2
Eastern Interior	107.2	148.4	154.4	165.4	148.4	154.1	166.3	154.0	154.0	154.9	150.6	153.4
Western Interior	37.1	83.1	106.9	109.9	83.1	102.6	117.8	101.1	101.5	105.3	110.2	101.2
Texas	16.5	90.2	137.7	138.8	90.3	138.3	133.0	136.6	137.1	135.9	137.2	140.7
Other East	109.2	141.2	154.7	166.4	141.2	156.1	167.7	155.0	155.4	157.7	155.5	157.0
TOTAL EAST	530.3	772.8	899.0	923.0	772.9	893.9	926.7	881.3	882.3	887.7	895.2	886.4
Powder River	6.2	16.6	16.6	20.2	16.6	16.6	20.5	16.6	16.6	17.0	16.3	16.3
Green River-Hams Fork	8.6	15.4	18.0	18.0	15.4	18.5	18.4	17.8	18.0	19.1	18.8	18.2
Fort Union	11.6	19.9	19.8	35.4	22.1	22.1	35.8	22.1	22.1	23.3	20.3	23.4
San Juan River	8.5	8.6	8.9	14.1	8.6	8.9	14.1	8.9	8.9	8.8	7.7	8.8
Uinta-Southwestern Utah	4.9	16.8	17.8	20.7	16.8	18.3	21.1	17.9	18.0	18.5	18.3	18.3
Denver-Raton Mesa	5.2	16.5	20.0	22.7	16.5	21.1	23.2	21.1	21.0	22.1	24.0	19.9
Other West	19.7	28.3	33.2	44.9	28.4	33.3	45.5	33.1	33.1	33.6	33.4	33.2
TOTAL WEST	64.7	122.1	134.3	175.9	124.4	138.8	178.6	137.4	137.7	142.4	138.8	138.1
TOTAL U.S.	595.0	894.9	1,033.3	1,098.9	897.3	1,032.7	1,105.3	1,018.7	1,020.0	1,030.1	1,034.0	1,024.5

TABLE 5-3 (Concluded)

COAL CONSUMPTION SUMMARY
(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1990 PROJECTIONS										
Northern Appalachian	163.0	178.9	210.1	210.1	183.6	210.3	312.9	210.1	210.1	210.1	210.1	210.1
Central Appalachian	50.7	65.6	84.7	85.3	65.6	84.7	100.3	86.3	84.8	85.4	84.6	82.4
Southern Appalachian	46.6	80.3	118.0	118.5	80.3	118.0	156.7	119.2	118.1	118.6	118.0	116.4
Eastern Interior	107.2	164.7	174.4	173.4	164.9	174.4	214.8	174.7	173.5	174.7	175.0	172.5
Western Interior	37.1	90.7	175.1	173.6	90.9	175.1	201.2	171.1	171.1	180.2	179.1	165.2
Texas	16.5	116.0	251.3	228.2	115.7	251.3	271.1	247.2	247.9	247.7	250.0	248.0
Other East	109.2	155.8	206.7	204.9	155.8	206.7	287.5	203.3	203.7	209.1	204.5	204.9
TOTAL EAST	530.3	852.0	1,220.3	1,194.0	856.8	1,220.5	1,544.5	1,211.9	1,209.2	1,225.8	1,221.3	1,199.5
Powder River	6.2	23.3	27.6	27.1	23.4	27.6	27.6	27.2	26.9	28.0	27.6	26.6
Green River-Hams Fork	8.6	18.1	20.1	18.3	18.2	20.1	19.1	18.4	18.2	20.7	20.1	18.2
Fort Union	11.6	30.1	44.0	48.7	30.1	44.0	47.4	44.6	44.9	46.9	39.4	45.2
San Juan River	8.5	10.5	13.6	13.3	10.7	13.6	24.6	13.6	13.4	13.5	13.6	13.2
Uinta-Southwestern Utah	4.9	21.7	21.8	21.7	22.3	21.8	29.1	20.5	20.7	22.0	21.8	20.9
Denver-Raton Mesa	5.2	23.4	30.3	30.6	23.4	30.3	35.3	29.6	29.7	31.1	31.3	28.1
Other West	19.7	38.9	70.6	66.3	39.2	70.6	91.7	66.3	66.3	71.1	70.8	67.1
TOTAL WEST	64.7	166.0	228.0	226.0	167.3	228.0	274.8	220.2	220.1	233.3	224.6	219.3
TOTAL U.S.	595.0	1,018.0	1,448.3	1,420.0	1,024.1	1,448.5	1,818.3	1,432.1	1,429.4	1,459.1	1,445.9	1,418.8

TABLE 5-4

FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES
COMPARISON OF 1985 AND 1990 REGIONAL COAL PRODUCTION LEVELS

(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	176.0	208.3	211.7	217.5	0.1	-0.1	-0.8	0.1	-	-1.3	-0.2	-0.6
Central Appalachian	206.8	202.7	205.5	178.8	-	-1.1	-2.9	0.1	-0.7	-13.0	-2.1	5.5
Southern Appalachian	23.4	18.0	27.5	42.7	-	-0.9	-2.1	-1.0	-	4.1	-5.4	-4.5
Eastern Interior	136.4	209.0	206.1	172.4	-	3.6	-11.4	-0.1	1.0	-10.0	-2.7	6.5
Western Interior	11.5	12.7	14.2	14.2	-0.1	-0.6	0.3	-0.5	-	-6.0	-3.4	1.6
Texas	14.1	62.4	64.0	48.6	0.1	2.3	-13.3	-0.3	0.6	-13.8	-6.3	14.6
Other East	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL EAST	568.2	713.1	729.0	674.2	0.1	3.2	-30.2	-1.7	-	-40.0	-20.1	23.1
Powder River	37.4	150.0	204.8	275.0	-	0.2	25.0	0.2	0.2	20.2	-0.2	-21.1
Green River-Hams Fork	25.7	40.0	76.0	99.6	-	4.0	30.4	1.9	1.0	36.0	36.0	-18.5
Fort Union	11.4	16.9	31.9	51.9	-	-	-	-	-	5.0	-10.0	5.5
San Juan River	8.8	15.0	24.8	39.7	-	0.2	0.3	-	-	5.2	-2.7	7.2
Uinta-Southwestern Utah	10.2	15.0	29.6	44.5	-	0.4	0.5	0.4	0.1	5.4	-3.2	-0.2
Denver-Raton Mesa	1.9	2.0	5.0	10.0	-	-	-	-	-	1.0	1.0	2.0
Other West	10.4	18.3	4.2	6.7	-	-1.2	-	-0.4	-0.4	2.6	2.4	-2.4
TOTAL WEST	105.8	257.2	376.3	527.4	-	3.6	56.2	2.1	0.9	75.4	23.3	-27.5
TOT. U.S.	674.0	970.3	1105.3	1201.6	0.1	6.8	26.0	.4	1.8	35.4	3.2	-4.4

TABLE 5-4 (Concluded)

FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES
COMPARISON OF 1985 AND 1990 REGIONAL COAL PRODUCTION LEVELS

(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1990 PROJECTIONS										
Northern Appalachian	176.0	193.8	219.4	212.6	-	0.7	40.2	-	0.2	- 1.6	2.9	5.9
Central Appalachian	206.8	191.3	211.2	196.6	-0.1	-5.0	21.0	-0.7	-1.2	- 8.2	- 5.7	14.2
Southern Appalachian	23.4	15.6	26.4	42.3	-	-1.0	- 1.9	-0.1	-	4.0	-11.9	-12.2
Eastern Interior	136.4	275.7	331.5	290.4	-1.0	-11.8	-10.3	-17.1	-3.5	-46.9	-19.0	49.6
Western Interior	11.5	13.1	25.5	26.6	-0.4	- 8.4	-12.6	- 6.2	-1.3	-15.3	-15.4	9.5
Texas	14.1	74.0	119.4	98.9	-1.0	-33.3	1.1	- 3.0	-3.6	-60.5	-39.8	- 8.4
Other East	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL EAST	568.2	763.5	933.4	867.4	-2.5	-58.8	37.5	-27.1	-9.4	-128.5	-88.9	58.6
Powder River	37.4	175.0	305.0	337.0	-	95.0	263.0	50.0	11.0	145.0	91.1	-35.9
Green River-Hams Fork	25.7	66.5	98.7	119.0	3.5	21.3	56.0	2.3	5.5	51.3	50.8	-35.9
Fort Union	11.4	21.9	51.0	94.9	-	-9.1	-13.0	-3.6	-0.4	0.9	-28.5	3.4
San Juan River	8.8	25.0	59.4	77.3	-	-9.4	- 2.3	-4.5	-1.0	0.6	- 1.7	3.6
Uinta-Southwestern Utah	10.2	19.8	45.0	65.0	0.2	-5.0	- 5.0	-3.0	-0.2	5.0	-16.7	-8.2
Denver-Raton Mesa	1.9	5.0	10.7	15.0	-	-0.7	-	-0.2	-0.1	-0.7	-3.2	-0.4
Other West	10.4	14.4	10.3	0.4	-	0.4	8.7	-1.7	-0.1	-6.6	-2.0	3.8
TOTAL WEST	105.8	327.6	580.1	708.6	3.7	92.5	307.4	-39.3	14.7	195.5	89.8	-69.6
TOTAL U.S.	674.0	1091.1	1513.5	1576.0	1.2	33.7	344.9	12.2	5.3	67.0	.9	-11.0

million tons, respectively. The no new leasing medium alternative would result in the production of 305 million tons.

Given the Powder River Coal Region's land ownership patterns and the economic desirability of the coal resources, this disparity is to be expected. The coal industry, as any private enterprise, seeks to maximize profits in part by minimizing costs. Producers are attracted by the Powder River Coal Region's fields in Wyoming and Montana with their thick coal seams and relatively low seam thickness to overburden ratios. Since the NCM production projections are based on a least cost linear programming model, the program alternative which depends on these projections similarly emphasizes production from the Powder River Coal Region. On the other hand, a policy of no new leasing would restrict available production both by preventing expansion of the Federal coal lease reserve base and by affecting the economic viability of private coal dependent upon adjacent Federal reserves for their development. The Powder River Coal Region is highly dependent on Federal leasing to expand production beyond currently planned levels.

Changes in western production from one alternative to another would lead to reactive changes in eastern and midwestern coal production. This result follows from the assumption that total regional energy demands (on a Btu basis) remains invariant under the program alternatives analyzed (for given low, medium, or high demand assumptions). The adjustments resulting from different western production levels create the greatest fluctuations in regions that are geographically close to the western coal supply areas, namely the Texas, Eastern Interior, and Western Interior Coal Regions. Furthermore, should the supply of coal in the Powder River Coal Region projected to flow to the Texas Coal Region markets be restricted under the no new leasing alternative, the energy shortfall would not be expected to be made up with coal supplied from the Northern Appalachian Coal Region.

5.2.1.2 Implications of Methodological Approach. As discussed in section 5.1, in defining production levels and flow distributions for the Federal coal management program alternatives, it was assumed that Btu demand in each of the 53 geographical areas analyzed would be specified at a constant level for each of the production levels in 1985 and 1990. For example, the Btu demand in the Northern Appalachian Coal Region at the medium production level would be constant for all mid-level production program alternatives analyzed. The specified area demand levels (in terms of total Btus of energy) correspond to the lease to meet DOE production goals levels as derived from the National Coal Model (NCM) output. The primary advantage of this assumption is that it enables a rapid redistribution of coal flows in response to projected changes in the level of future western coal production. Other approaches were not available to generate comparable data essential to the timely completion of this environmental impact statement. Major implications of the constant demand and related methodology assumptions are discussed below.

The first implication relates to the general acceptability of the NCM high, medium, and low coal demand estimates. The NCM projects a 1985 medium level demand of 1.1 billion tons, a 64 percent increase over the 1976 production of 674 million tons. Many believe growth of this magnitude is overly

optimistic, particularly in view of the myriad of uncertainties involved in estimating coal demand at such high levels over the relatively short time between 1979 and 1985. A new iteration of the NCM, may, with updated assumptions such as competing fuel costs, transportation rates, and environmental control standards, produce total United States coal demand projections which would be more generally accepted by governmental and industry spokesmen. Nevertheless, for the purposes of this environmental impact statement, the projections derived from NCM output effectively bracket the range of regional coal demand in 1985 and in 1990.

The methodology also assumes that the proportional split between underground and surface mining would remain constant for a given production level for a given year for all alternatives analyzed. The proportional split does, however, vary between production levels (high, medium, and low) and between years (1985 and 1990). It is likely that the relative economics of extraction could shift slightly to favor one extractive method over another for incremental changes in production in a given year between the program alternatives. However, the degree of accuracy jeopardized by this approach appears to be minor. Also, the coal regions experiencing the greatest production variations among the alternatives (i.e., Powder River and Texas) are not projected to produce any underground mined coal.

The coal management program alternatives utilize consumption projections derived from the NCM output. These projections assume a constant proportional allocation of coal in a region among various coal conversion and utilization technologies for a given national coal production level (low, medium, or high). For example, the proportional split among coal-using sectors, (i.e., steam electric generation, coke production, synthetic fuels) does not vary between alternatives at any specified production level. The proportional split does, however, vary between production levels, (low to medium, medium to high, etc.) and between years (1985 versus 1990).

A final implication concerns the constant regional demand assumption. The economics of coal use are such that a change of only a few cents per million Btus of energy could influence both the consumptive demand for coal and the relative economic desirability of developing regional coal reserves. Demand assumptions underlying the various production levels considered in the NCM reflect these considerations. The methodology used to project production levels under all Federal coal management alternatives implicitly reflects the price and quantity relationships postulated for the various production levels used in producing NCM production/consumption estimates. A more explicit, sophisticated methodology employing consideration of dynamic interactions and cross elasticities of energy substitutes would, in all probability, yield more precise estimates. However, as discussed in section 2.5, the availability of these alternative energy sources is limited. In addition, to the extent the NCM uses a least cost linear programming approach, restrictions on the availability of the most economically recoverable coal reserves (private or Federal) would invariably lead to higher fuel costs, with potentially serious national economic growth implications.

REGIONAL IMPACTS

5.2.2 Physical Impacts

This section analyzes the environmental impacts of the Federal coal management program alternatives on selected physical resources. Topography, geology, minerals, and soils impacts are treated generically, as the level and types of impacts are highly dependent on the physical setting of individual mines and other coal related activities. While land disturbance, water quality, and air quality analyses in this section also involve a high degree of site specificity, a more detailed discussion of these parameters is included in order to more fully relate the inter-regional and inter-alternative effects of the coal management program.

5.2.2.1 Land Disturbance and Reclamation. This section addresses the amount of land in each coal region that would be temporarily and permanently disturbed during the periods from 1976 to 1985 and from 1986 to 1990 for each production level of each alternative. Land committed to mining and to coal beneficiation, conversion, and utilization plants is considered. Substantial quantities of land would also be disturbed by residential and industrial development needed to support miners and their families. However, due to the multiplicity of site-specific factors which would dictate acreages committed to such developments, their quantification is beyond the scope of this document.

The total land area that would be disturbed by coal development activities under the no new leasing alternative is listed by coal region and coal production projection in Table 5-5. Land which would be disturbed due to implementation of the remaining alternatives is tabulated according to its variation from the no new leasing values. Acres presented represent total land committed to coal mining operations during the relevant time periods without regard to reclamation and are for comparison purposes only. Reclamation potential and acreages which would be permanently disturbed are discussed later in this section.

Table 5-6 provides a comparison of the eastern and western coal regions at the medium coal production projections.

Midwestern coal regions would be impacted substantially more than the eastern or western regions regardless of the coal management program implemented. For the preferred program, 44 percent of the total land which would be disturbed in the United States by coal development activities would be in the Eastern Interior, Western Interior, and Texas Coal Regions; 34 percent would be located in the Appalachian Coal Regions and 21 percent in the western coal regions.

The coal regions are listed in Table 5-7 in order of decreasing surface area that would be disturbed under the preferred program (medium level). Greatest surface disturbance would occur in the Texas Region (445,000 acres) under this alternative. The Eastern Interior (404,000 acres) and Northern Appalachian (339,000 acres) Coal Regions would rank second and third, respectively. The amount of land which would be disrupted in all of the western regions would exceed that in Texas by only 15 percent.

Estimates of the amount of land that might not be reclaimed are presented in Table 5-8. The majority of this land would be that committed to buildings or other areas

associated with coal mining and coal conversion and plant operations.

The Northern Appalachian Coal Region would contain at least 87 percent more unreclaimed land than any other region. The eastern regions as a whole would contain 54 percent and 97 percent more unreclaimed land than the midwestern and western regions, respectively.

Reclamation Potential. All mined land must be reclaimed. However, time and cost requisites, projected use of reclaimed land, and reclamation-related impacts vary considerably among regions. In the western coal regions, the dominant land use is rangeland. Table 5-9 summarizes the relative reclamation potential of each western region based on a scale of -8 to +8 with the latter representing areas easiest to reclaim [3]. The -8 to +8 scale considers (1) productivity, toxicity, and stability (texture, slope) of soils; (2) suitability (erosion control and resilience) of vegetation for the declared end use of the reclaimed land; and (3) annual amount and seasonal distribution of mean precipitation.

Packer [4] has estimated that areas with -8 and +8 reclamation potentials in the Northern Great Plains could be reclaimed to premining rangeland production levels in 15 years and 5 years, respectively. Cropland areas could be restored in 15 years and 1 year, respectively. Assuming a direct correlation between the reclamation potential scale (-8 to +8) and Packer's time estimates, Table 5-9 estimates the years necessary to reclaim mined land to rangeland and cropland.

The dominant land use in the Western Interior and Eastern Interior Coal Regions is agriculture; much of this land is prime farmland [5]. The ability to restore prime farmland to original productivities has not been demonstrated, but is anticipated to require 5 to 15 years [6,7]. Reclamation of rangeland in the Western Interior and Eastern Interior Coal Regions can occur in 3 years [7].

Rangeland is the dominant land use in the Texas Coal Region, with reclamation commonly occurring within 1 year [8].

Forest land is the dominant land use in the Northern, Central, and Southern Appalachian Coal Regions. Natural maturation of coniferous and hardwood communities on abandoned old-fields averages about 60 and 150 years, respectively [9]. Present forestry techniques have reduced maturation time periods by about 50 percent for both conifer and hardwood stands [10]. Whether long-term post-mining productivities can equal premining levels is unknown due to the relative infancy of timberland reclamation practices [10]. Estimates of the cost of reclamation are presented in Appendix I.

The Surface Mining Control and Reclamation Act of 1977 (Section 515(c)(3)) requires that applicants requesting mine permits first have proposed postmining land uses approved by local and state land use planning agencies. In addition, any state or Federal agency which is determined to have an interest in the proposed use will be allowed 60 days to comment on the proposal.

In the western coal regions, the postmining land use would be limited to grazing as the dominant land use. Because of the difficulties associated with overcoming precipitation deficits, this dominant land use should not change.

TABLE 5-5
TOTAL LAND DISTURBANCE: COMPARISON OF ALTERNATIVES^(a)
(Acres)

COAL REGION	NO NEW LEASING (b)			PREFERRED PROGRAM			PRLA'S ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1976 to 1985 PROJECTIONS											
Northern Appalachian	263,670	258,700	267,110	40	-50	-630	-7,210	-7,240	-7,690	-100	-7,460
Central Appalachian	147,150	157,960	147,540	0	-1,080	-2,390	-390	-740	-6,240	-1,310	1,870
Southern Appalachian	111,600	153,010	159,700	0	-3,110	-550	-2,360	-2,110	-30	-8,000	-4,860
Eastern Interior	260,550	262,950	258,350	0	1,350	-2,500	-530	-10	-2,060	-6,400	1,070
Western Interior	132,820	163,860	168,160	-60	-6,710	11,070	-8,650	-7,480	-9,820	70	24,100
Texas	171,080	237,070	226,490	210	2,600	-18,510	-1,740	-360	-13,430	-5,700	15,500
Powder River	67,830	84,260	109,470	0	200	8,140	50	110	-6,850	-320	-6,560
Green River-Hams Fork	49,920	82,100	101,060	0	3,620	24,330	1,070	780	29,640	29,260	-14,350
Fort Union	35,060	41,900	74,900	2,980	3,150	520	3,160	3,160	7,510	-4,750	7,870
San Juan River	22,730	31,000	48,840	0	90	170	-70	-70	4,080	-3,520	5,760
Uinta-Southwestern Utah	25,500	27,930	32,480	0	770	610	200	300	1,840	160	600
Denver-Raton Mesa	21,960	29,210	35,770	0	1,270	630	1,210	1,210	4,460	7,040	1,830
1986 to 1990 PROJECTIONS											
Northern Appalachian	122,240	140,625	204,000	1,785	180	2,905	-35	-5	-280	565	845
Central Appalachian	77,555	93,310	105,740	-20	-935	-820	950	-185	-370	-1,150	1,080
Southern Appalachian	53,565	81,555	104,560	0	-235	6,135	735	55	1,305	-2,800	-3,835
Eastern Interior	131,265	141,965	157,770	10	-1,770	25	-1,455	-1,065	-6,295	-4,305	5,500
Western Interior	66,975	129,380	154,430	-25	-3,305	11,600	-4,955	-3,155	-2,165	-3,565	-3,985
Texas	107,595	218,420	243,380	-600	-13,200	19,965	-3,955	-3,755	-26,410	-16,660	-5,615
Powder River	42,275	62,675	66,160	85	14,490	42,675	7,270	1,300	22,285	13,900	-5,840
Green River-Hams Fork	37,165	49,110	55,985	1,330	8,225	23,670	-370	950	20,435	19,860	-1,551
Fort Union	25,575	42,585	56,435	0	-2,480	3,415	-540	550	2,170	-10,905	1,815
San Juan River	17,205	32,150	47,460	190	-3,615	775	-1,675	-440	350	-1,245	1,345
Uinta-Southwestern Utah	17,060	17,195	22,435	480	-250	805	-910	-640	550	-1,560	-985
Denver-Raton Mesa	17,155	22,615	26,075	55	40	2,475	-405	-340	1,405	105	-1,245

(a) Represents total permanent and temporary land disturbances assuming no reclamation.

(b) Represents total acres disturbed under the no new leasing alternative. Remaining columns represent differences from the no new leasing levels.

TABLE 5-6

COMPARISON OF SURFACE AREAS THAT WOULD BE DISTURBED BY COAL MANAGEMENT ALTERNATIVES
FOR THE PERIOD 1976-1990 AT MEDIUM COAL PRODUCTION PROJECTIONS (a)

COAL REGION	NO NEW LEASING	PREFERRED PROGRAM	LEASE PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMI- NATION
Eastern Coal Regions (Northern, Central, Southern Appalachian)	885	880(-0.6)	877(-0.9)	875(-1.1)	872(-1.5)	872(-1.5)	873(1.4)
Midwestern Coal Regions (Eastern and Western Interior and Texas)	1154	1133(-1.8)	1133(-1.8)	1138(-1.4)	1094(-5.2)	1117(-3.2)	1190(+3.1)
Western Coal Regions (Powder River, Green River-Hams Fork, Fort Union, San Juan River, Uinta-Southwestern Utah, Denver-Raton Mesa)	523	548(+4.8)	532(+1.7)	530(+1.3)	625(+19.5)	571(+9.2)	511(-2.3)

(a) Numbers in parentheses represent percentage change from the no new leasing alternative.

TABLE 5-7

TOTAL SURFACE AREA THAT WOULD BE DISTURBED
IN EACH COAL REGION FOR THE PERIOD 1976 - 1990
IF THE PREFERRED PROGRAM WERE IMPLEMENTED
AT THE MEDIUM COAL PRODUCTION PROJECTION

COAL REGION	THOUSANDS OF ACRES	PERCENT OF TOTAL
Midwestern Regions		
Texas	445	17.4
Eastern Interior	404	15.8
Western Interior	<u>283</u>	<u>11.1</u>
Subtotal	1,132	44.2
Eastern Regions		
Northern Appalachian	399	15.6
Central Appalachian	250	9.8
Southern Appalachian	<u>231</u>	<u>9.0</u>
Subtotal	880	34.4
Western Regions		
Powder River	162	6.3
Green River-Hams Fork	143	5.6
Fort Union	85	3.3
San Juan River	60	2.3
Uinta-Southwestern Utah	46	1.8
Denver-Raton Mesa	<u>53</u>	<u>2.1</u>
Subtotal	549	21.4
REGION TOTAL	2,561	100.0

TABLE 5-8

ESTIMATES OF DISTURBED LAND (1976-1990)
COMMITTED TO LONG TERM USES UNDER THE PREFERRED PROGRAM

COAL REGION	ACRES	PERCENT OF TOTAL ^(a) LAND DISTURBED
Midwestern Regions		
Texas	44,500	10
Eastern Interior	68,700	17
Western Interior	<u>31,100</u>	<u>11</u>
Subtotal	144,300	13
Eastern Regions		
Northern Appalachian	139,700	35
Central Appalachian	80,000	32
Southern Appalachian	<u>71,600</u>	<u>31</u>
Subtotal	291,300	33
Western Regions		
Powder River	47,000	29
Green River-Hams Fork	25,700	18
Fort Union	24,700	29
San Juan River	18,600	31
Uinta-Southwestern Utah	10,100	22
Denver-Raton Mesa	<u>11,100</u>	<u>21</u>
Subtotal	137,200	25
REGIONAL TOTAL	572,800	22

(a) Represents land committed to long term uses as a percent of total land disturbed presented in Table 5-7.

TABLE 5-9

TIME REQUIRED TO RECLAIM MINED-LAND
(WESTERN REGIONS) (a)

COAL REGION	RECLAMATION POTENTIAL(b)		TIME TO RECLAIM (years)	
	WEIGHTED AVERAGE(c)	RANGE	RANGELAND	CROPLAND
Powder River	0.9	-2 to 5	9.6	4.9
Green River-Hams Fork	0.2	-2 to 4	10.0	7.7
Fort Union	3.4	1 to 8	8.0	4.9
San Juan River	-6.9	-8 to 3	14.1	14.0
Uinta-Southwestern Utah	-5.0	-5	13.4	12.3
Denver-Raton Mesa(d)	-5.0	-5	13.4	12.3

(a) Source: Reference Numbers 3 and 4.

(b) Based on scale of -8 to +8 developed in Reference Number 3.

(c) Based on total acres which would be mined through 1980 and reclamation potential of active mines.

(d) Same value as Uinta-Southwestern Utah Region due to regional productivity and latitudinal similarities.

REGIONAL IMPACTS

In the midwestern regions, it appears that forest land acreages would decrease and grazing land would increase. Presently approved reclamation plans in Illinois may cause a 20 percent increase in pastureland and a 19 percent decrease in forest land. Cropland would remain about the same [5]. Carter et al. [11] and Kennedy et al. [12] attribute the increase in pastureland to its much lower cost of reclamation (about 71 percent).

Coal companies have recently given more emphasis to reclaiming surface-mined land to recreational and housing developments [13]. However, these have been isolated endeavors primarily because marketability has not been thoroughly investigated.

In the Texas Coal Region, reclamation of the dominant land use, grazing land, would require only 1 year at a cost of only 15 cents/ton of coal mined. Rangeland dominance, therefore, is not expected to be impacted by reclamation constraints.

In the Appalachian Coal Regions, a reduction of forest land (the dominant land use) is anticipated. Due to the proximity of numerous densely populated cities flanking the Appalachian Coal Regions, an opportunity would be provided for increased land values and stimulation of local economies by establishing recreational facilities and second home communities.

The precipitation patterns over much of the western coal regions are highly variable and precipitation is consistently low. Low precipitation and, hence, low available moisture are most serious especially in two regional areas; the San Juan River area and the Red Desert area located in the Green River-Hams Fork Coal Region. Both regions average only 6 to 9 inches of precipitation annually; they frequently receive less.

Irrigation is not a solution for all mines in semi-arid sites since water rights are usually not available. The question of whether or not initially irrigated plant communities on reclaimed areas could maintain native area densities for an indefinite period of time has not been answered. The controversy centers around the fact that initial establishment rates under sprinkler irrigation are higher than normal, and a drought year may severely impact the reclaimed community [14,15].

Surface coal mining in midwestern areas has encroached on valuable prime agricultural lands. In 1976, for example, 3-year permits were issued to surface mine 17,230 acres within the State of Illinois. Of this total acreage, 12,954 acres, or about 75 percent, is classified as prime agricultural land by the U.S. Soil Conservation Service [5]. The preferred program at the medium production projection would increase annual land disturbance in the Eastern Interior Coal Region. This increase in surface mining activity would undoubtedly advance the disturbance of prime agricultural lands and affect both the economy and environments in midwestern surface mining areas. The major concern of mining prime agricultural lands is whether or not the technology or knowledge exists which would allow the successful reestablishment of those soil factors which are conducive to successful crop production.

The Surface Mining Control and Reclamation Act of 1977 specifies that the root zone of plants be reestablished following mining by topsoil and/or subsoil segregation and replacement to achieve both a texturally and chemically suitable root environment. These requirements are not

oriented to midwestern states that are major producers of surface mined coal [15]. For example, Ohio, Illinois, and North Dakota have had reclamation regulations requiring topsoil segregation and replacement for at least 2 years [16].

Expanded coal production in the East would result in increased water pollution even though great strides have been made in developing mining and reclamation technologies which minimize the effects of land disturbance [15]. Although emphasis is placed upon augmenting production from underground mining, surface mining would still play an important role.

Sediments eroded from surface mines, coal refuse areas, and disposal areas of acid mine drainage treatment sites are a major problem in the eastern regions [15]. Additional pollution would result from the erosion of haulage roads used for both surface and underground mines and from the land disposal of fly ash, bottom ash, and scrubber sludge. With an increased use of coal in the aforementioned areas, greater impacts on health and the environment would be evidenced.

Acidity is a major factor in the Northern Appalachian Coal Region including the area of Pennsylvania, southeastern Ohio, northern West Virginia and Maryland [15]. In this area, rock strata overlying the coal are low in fertility and high in acid-producing materials.

Damage to off-site properties could result from the corrosive action of acid mine drainage, from erosion of surface materials, and from slides from the outslope areas of contour mines [15]. In 1965, eastern Kentucky had slides on 12 percent of its contour mines, causing flood hazards by blocking small streams and natural drainage patterns. In addition, sediment basins at the head-of-hollows would be flood hazards if improperly designed; however, there is evidence that properly designed surface mine sediment structures have lessened the effects of the 1977 spring floods in southern West Virginia.

5.2.2.2 Topography. An impact on the topography of an area would occur if a permanent change in the general configuration of the land surface were to result from coal related development. The concept of permanent change is a key factor in determining the topographic impacts of surface mining under the provisions of the Surface Mining Control and Reclamation Act (SMCRA). The environmental protection performance standards of that law (Section 515(c)(3)) operate to mitigate the significance of topographic changes compared with those changes that would occur under conditions of no control.

During early phases of coal development, topographic changes would be limited to the grading required for access roads and for the preparation of the drill sites used to determine the overburden and coal-deposit dimensions. The outline drilling program requires that holes be drilled at quarter-mile intervals; this involves approximately 35 holes per 1,000 acres of leasehold. Except in very rugged terrain, grading for access roads and drilling sites would involve a negligible portion of the leasehold.

Topographic impacts could also occur during premining site preparation and facilities construction. Cuts and fills could be required for coal haul roads, and some surface grading might be needed for mine-support facilities such as offices, warehouses, shops, and equipment parking or storage

areas. The amount of such changes would be highly dependent on the characteristics of a particular site. However, the topographic changes resulting from these activities would not generally be extensive enough to significantly impact an area's topography.

The extent of topographic disturbance due to coal extraction operations differs considerably between surface mining and underground mining. By far, the greater disturbance is associated with surface mining. Surface mining involves the removal of the overburden and the extraction of the exposed coal seam or seams. The primary impact of this action would be the lowering of the surface in the area mined to depths that vary from a few feet to hundreds of feet, depending on the combination of overburden depth and coal seam thickness. If left in its surface mined form, the area would suffer a significant topographic impact. However, SMCRA (Section 515(b)(3)) requires that all overburden material be backfilled and graded to restore the approximate original contour of the land.

Section 515(b)(3) also covers provisions in SMCRA for instances where insufficient or excess overburden does not allow restoration of original contours. The geological nature of the overburden and the ratio of overburden thickness to coal seam thickness are factors that would determine whether there is excess or insufficient overburden. During excavation, the overburden material would be broken up and a volumetric expansion or bulking would occur, predominately related to the geological nature of the material. This overburden bulking would usually range from 10 to 20 percent and could vary between regions, within regions, and even within a particular leasehold depending on the geological materials encountered. If a 20-foot coal seam were to be mined in an area that required the removal of 200 feet of overburden material having a 10 percent bulking factor, backfilling and grading of the overburden could restore the approximate original contour of the land with all highwalls, spoil piles, and depressions eliminated. If the overburden to coal seam thickness ratio were greater than the percent of overburden bulking, there would be excess overburden. Conversely, if the overburden to coal ratio were less than the percent of bulking, there would be insufficient overburden and a depression would remain after mining reclamation. Among the various coal regions, the Powder River Coal Region, with its 26-foot average seam thickness, would have a much higher proportion of lowered topography than the other regions. Surface lowerings of 25 to 40 feet have been experienced at some present mining operations in this region involving coal seams up to 70 feet thick with overburden thicknesses averaging 150 to 250 feet. The conditions of both hill and depression formation are covered under SMCRA which requires that the overburden material be backfilled, graded, and compacted (where advisable) to the lowest practicable grade but not more than the angle of repose.

Another area of topographic impact resulting from surface mining operations involves the general shape of the restored land. Regardless of whether the restored area is at the same elevation, raised, or depressed relative to the original elevation of the area, the landforms resulting from restoration activities would have more smoothly contoured surfaces than the original landscape; most of the microrelief features, such

as small ledges, rock outcrops, and natural steep banks would be eliminated.

Underground mining could impact surface topography through deformation of the geologic strata above the coal extraction area. This could lead to surface lowerings, tension cracks, or compression bulges. These types of impacts could play a major role in future use of the land surface above the mine workings. The type and magnitude of such surface changes is highly site-specific and cannot be generalized for any region. Conditions which affect subsidence involve the lithology, structure, and thickness of the overburden; the geometry of mine workings; coal-bed thickness and the rate of mining; and the direction of dip of any coal bed relative to its outcrop [17]. Underground mining activities can be designed to take into account those factors which influence subsidence processes. New techniques, such as the use of remote sensing imagery, are being developed to provide better information for evaluating mine ground stability and potential areas of subsidence [17,18,19].

Other activities associated with coal development such as plant construction, utility and transportation corridor construction, and employment-related factors might also produce topographic changes. New roads or rail lines might require cuts or fills; coal-conversion and electric-generation facilities would generally require site preparation in the form of some degree of surface grading or leveling; and community-development activities (housing, utilities, schools, etc.) associated with coal development would also involve a certain amount of surface grading. These changes would also be site dependent and the magnitude of such changes from a topographical basis should not be significant. The overall effect on topography would be moderate alterations in land contours of the acres involved.

5.2.2.3 Geology. Mining is the only phase of the coal development cycle in which significant geological impacts could occur. Although coal processing, transport, conversion, and use might produce minor topographic changes, the impacts of such changes would not be of a magnitude to significantly alter the geologic character of an area.

In the mining phase, surface mining operations would produce significantly greater geologic impacts than underground operations. The exact extent of surface mining impacts would be directly related to the geological characteristics and thickness of the overburden, and cannot be generalized for a particular region. When overburden is broken up, removed, and later replaced as spoil, the geological structure and natural stratification of the overburden is destroyed and its physical and chemical properties are altered. Although structural alterations would prevent any future scientific study of the original nature and structure of the overburden, much of the needed information would be collected during earlier development activities. Exploratory drilling includes the collection of core samples for mineralogical, physical, and chemical testing and also includes bore hole testing to collect data on the seismic, gravimetric, and magnetic characteristics of the different underground strata. The breaking up of the overburden and the mining of coal could also affect groundwater through the disruption of any aquifers in the overburden material or in the coal itself. This area of impacts is described in detail in section 5.2.2.6.

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Paleontological resources could be affected by the disturbance, destruction, or removal of fossil material from overburden during stripping and backfilling operations. The exposure of fossiliferous rocks in an area could also lead to losses resulting from unauthorized fossil collecting and vandalism. The significance of impacts on paleontological resources from stripping operations cannot be meaningfully assessed without data collection guidelines, assessment procedures, and evaluatory criteria. The Bureau of Land Management and the U.S. Geological Survey are currently developing a mechanism to provide for the protection of paleontological resources on Federal lands. The overall impacts from a geological standpoint would be minimal. Likewise, paleontological resources should sustain only minimal impacts, except in site specific situations.

Another category of potential geological impacts involves the Department of the Interior's Natural Landmarks Program that affects other Federally designated scenic and natural areas. A certain number of these areas would be considered as unsuitable for coal mining under the lands unsuitability criteria set forth in Table 3-1 above. Scenic Federal lands designated by visual resource management analysis as areas of outstanding scenic quality and/or of high visual sensitivity - Class I or II - but not currently on the National Registry of Natural Landmarks would, in general, also be considered unsuitable for coal mining. An exception is that a lease may be issued in a scenic area only if the land management agency determines that coal mining will not significantly diminish or adversely affect the scenic quality of the designated area.

The objective of the Natural Landmarks program is to assist the preservation of the various categories of significant natural areas which would illustrate the diversity of the country's natural history. The types of nationally-significant geological features that could qualify for natural landmark designation are outstanding formations significantly illustrating geologic processes, significant fossil evidence of the development of life on earth, and examples of the scenic grandeur of our natural heritage [20]. Efforts to inventory significant landmarks of all the natural regions are continuing through a variety of natural-region theme studies. It is not possible at present to determine the magnitude of potential impacts on these landmarks without being site specific. The nature of the landmark would be a factor in determining whether coal development activities would cause a significant impact. For example, a landmark which owed part of its significance to the ability to view it from a particular vantage point could be impacted by the visual intrusion of man-made structures or terrain alterations while a significant fossil area could remain unaffected by such activities so long as they did not physically disrupt the fossil formations.

In general, all of the phases of the coal cycle contain elements which could possibly affect natural landmarks. However, surface mining activities would present the highest probability of potential impacts. Thirteen landmarks currently included on the National Registry of Natural Landmarks have been reported to be threatened by various types of surface mining [21]. Although only one of these sites specifically involved coal mining, these cases are illustrative of potential coal development impacts on designated natural landmarks. Coal development activities could also alter a site so as to preclude its possible designation as a natural landmark. Other

activities which would have potential for landmark impacts include uncontrolled fossil collection due to mine-related population increases and community developments which could preempt the designation of an area as a natural landmark.

Natural areas (Federal lands designated as natural areas or as Natural Landmarks) would, in most instances, be considered unsuitable for coal mining under the unsuitability criteria. An exception is that leasing may be permitted in natural areas or sites if the land management agency determines that (1) the area or site is only of regional or local significance and the state concurs that leasing may be permitted; (2) the use of appropriate mining technology would result in no significant adverse impact to the area or site; and (3) the mining of the coal resource would enhance information recovery (e.g., paleontological sites). The extent of the areas that would be considered as unsuitable for coal mining because of their natural or scenic qualities cannot be determined at the programmatic level.

5.2.2.4 Minerals. Mineral resources would be impacted by their extraction, by the establishment of conditions which preempt any future development, or by conditions which delay their development. The major impacts of any coal management program would be the permanent depletion of a nonrenewable resource through the production and consumption of the tonnages of coal associated with each of the alternatives. Additional minor impacts would occur through the use of sand and gravel or other materials for road-base material and as construction aggregate. These materials would be required in varying quantities in all phases of coal development and in any community development that would occur due to coal development. Although the requirements are not known at this time, regionally significant impacts would not be expected because of the widespread availability of these materials.

Both surface and underground mining have the potential to preempt future development of other mineral resources. The magnitude of any preemption cannot be estimated at the programmatic level due to the site-specific nature of the factors affecting such preemption. These factors include the mineral-resource character of surface mine overburden and the location of any deep coal bed relative to other mineral commodities above or below the coal deposit. An example of potential preemption by surface mining operations can be illustrated by the Wasatch and Fort Union Formations in the Wyoming portion of the Powder River Coal Region. Uranium and coal have both been found in these formations. The stripping of overburden to reach a coal seam would intermix any uranium with the rest of the overburden and eliminate the possibility of any future uranium extraction. The uranium occurring under such conditions usually consists of deposits that are presently uneconomical to recover. However, if future uranium market conditions or uranium extraction technology were to change to make recovery of this deposit economically attractive, such recovery would have been preempted by the intermixing with the rest of the overburden. The extent to which this might occur for uranium or other minerals cannot be projected for any of the coal regions since it is dependent on the site-specific mineral characteristics of individual leaseholds. Mineral development preemption could also occur

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with the development of new communities or the expansion of existing communities if such development were to occur above mineral deposits.

Coal mining operations could also conflict with oil and gas recovery operations, either by preempting development or by delaying development for the life of the coal mining project. In a few instances, coal deposits occur below or on the same horizon as a commercial oil or gas deposit. Simultaneous operation of a coal mine and a producing oil or gas field have presented some difficulties. Regulations [30 CFR211] have been established by the Geological Survey to deal with these situations. Standard drilling procedures would not interfere with underground coal operations if coal seam intersections were properly cased. Standard casing would seal underground workings so that no hydrocarbon vapors could enter the coal seam from the well to create safety problems.

The extraction of one resource sometimes should occur after extracting the other. Where a mining operation follows the extraction of petroleum products, for example, the location of oil and gas wells would have to be determined by the mining company in order to leave safety pillars around the wells. It should be noted that in cases of coal mining requiring sequential extraction, it is generally more prudent, for technological reasons, to extract the coal resource before the oil and gas resource.

5.2.2.5 Soils. Coal development activities could cause soil impacts ranging from minor, short-term disturbances to significantly adverse, long-term alteration of soil characteristics. Stripping or grading operations could drastically alter soil characteristics through the mixing of the soil with the subsoil and underlying rock material. Horizons of topsoil could be saved for use in reclamation, thereby increasing the potential for productivity in the postmining phase. The natural soil structure would be broken up, soil compaction would cause lower permeability, soil microorganism would be buried, and nutrient cycling and established soil climate relationship could be completely altered. Overburden removal could also bring to the surface and mix with the soil those elements that are either toxic to plant growth or toxic to animal life that feed on the plants.

All land disturbances would result in the exposure of a range of soil materials of varying particle size to the action of wind and water. Soil productivity, permeability, and infiltration rates would be reduced, increasing runoff, soil erosion, and sedimentation. Wind action, which is variable both among the regions and within a single region, would cause fine soil particles (silt and clay) to be lifted into the atmosphere, reducing air quality and increasing soil loss. However, estimates of impacts on soils can only be made on a site-specific basis after haul roads, plant facilities, utility corridors, and other mine development activities have been identified.

Because of the provisions of Section 406(a) and Section 508 (a)(5) of the Surface Mining Control and Reclamation Act that pertain specifically to topsoil handling and restoration, potentially adverse soil impacts such as maximum topsoil removal and improper soil substitution and compaction can be minimized. The mining and reclamation plan for a particular leasehold must include soil surveys provided by the lessee. Such surveys would identify physical

and chemical characteristics together with the geographic extent of the leasehold soils to provide the basis for an effective reclamation plan. The wide variability of soil types is well illustrated by the proposed mining and reclamation plan for a Powder River Coal Region mine. This plan included a soil survey that identified 28 different soil types within a 5,800-acre leasehold [22].

5.2.2.6 Water Impacts. The total yearly water makeup requirements under the no new leasing alternative would range from 3.1 million acre-feet to 3.7 million acre-feet in 1985; by 1990, the range would be from 3.4 million acre-feet to 4.8 million acre-feet. Water use requirements in the 12 coal regions reflect the degree of coal development in each region (see Table 5-10).

Both water availability and water quality would be affected by a Federal coal management program. Water to meet mining, cleaning, and conversion needs would be drawn from available surface water and groundwater sources. Depending on local conditions, these water sources may or may not be adequate to support the increase in coal development activities projected for 1985 and 1990. Following its use, a volume of water would be discharged to the environment. The quality of this fluid would have been changed during its use. Such quality changes may include the addition of total dissolved solids, including heavy and trace metals as well as the more common cations and anions, the lowering of pH, and the addition of heat. Even with controls, some release of these substances would occur either directly into surface or ground waters or indirectly as leachates from solid waste or disposal sites. Consumptive uses could also increase salinity and concentrations of pollutants downstream from the point of diversion. Additional water degradation may occur as a result of mine drainage and runoff from storage, overburden, and spoil piles.

An increased population and industrial growth associated with coal development would exert additional water demands and would introduce quantities of salts, nutrients, organic materials, bacteria, pesticides, trace elements, heavy metals, etc. into surface waters, and could overtax existing sewage treatment facilities. Actual impacts on both water supply and quality would be site specific, and would depend on such factors as streamflow characteristics and present water quality. For conversion facilities and mines located near the upper reaches of streams where the flow is low, impacts on water quality could be significant.

Actual impacts at a specific site may differ from regional impacts due to local characteristics at that site. The analysis of water availability is based on preliminary data on water flow and consumptive water use compiled by the U.S. Water Resources Council [23]. The data are based on watersheds. Each major watershed in the United States is divided into subunits called aggregated subregions, or ASRs. The ASRs are listed in Appendix E. It is necessary to choose the ASR(s) which overlap most closely with the coal regions examined in this statement. As an example, the Uinta-Southwestern Utah Coal Region spans both ASRs 1401 and 1402. The data from these two ASRs are, therefore, summed in order to examine the water availability in that region.

Since the water supply in a region is affected by all upstream uses, it is also necessary to identify the regions which

TABLE 5-10

NO NEW LEASING ALTERNATIVE
WATER MAKEUP (WITHDRAWAL) REQUIREMENTS

(1000 acre-feet per year)

COAL REGION	1985			1990		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Northern Appalachian	566.2	563.8	565.1	559.4	651.0	663.0
Central Appalachian	186.9	212.1	211.0	242.5	309.7	309.3
Southern Appalachian	265.6	355.1	352.7	264.3	392.3	397.1
Eastern Interior	497.9	516.6	542.2	554.6	582.0	558.7
Western Interior	286.0	367.4	378.0	310.2	597.0	586.4
Texas	310.7	471.0	474.0	397.0	864.0	840.6
San Juan River	30.7	32.6	51.6	38.4	42.1	52.4
Uinta- Southwestern Utah	58.8	61.8	70.9	76.4	74.7	76.6
Green River- Hams Fork	55.2	66.7	68.2	66.2	64.4	70.4
Powder River	67.7	71.6	84.4	92.4	91.6	110.0
Fort Union	61.9	55.5	114.9	93.5	138.2	154.9
Denver-Raton Mesa	54.3	67.0	75.7	78.3	101.5	92.8
Others	556.3	600.4	680.8	631.2	906.8	887.1

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are located in the lower or central areas of watersheds. In order to obtain a realistic analysis of future water supply in such regions, the future upstream consumptive demands must also be determined. For instance, the Green River-Hams Forks Coal Region is also contained in ASR 1401, upstream from the Uinta-Southwestern Utah Coal Region. Therefore, any future increases of consumptive water requirements in the Green River-Hams Fork Coal Region (including coal development under any of the alternatives) would deplete the water supply flowing through the Uinta-Southwestern Utah Coal Region. Additionally, parts of the San Juan River Coal Region (contained in ASR 1403) are downstream from both the Green River-Hams Fork and Uinta-Southwestern Utah Coal Regions. As a result, any future increases of consumptive water requirements in ASRs 1401 and 1402 would decrease the water flow, and hence, availability, to those parts of the San Juan River Coal Region. This means that water consumption for coal development and for nonenergy-related developments in the Green River-Hams Fork and Uinta-Southwestern Utah Coal Regions must be deducted from future supplies in the San Juan River Coal Region. The ASRs used in the analysis of each coal region are listed in Table 5-11. The points in the ASRs at which the flows are measured are shown in Figure 5-2 and are listed in Appendix E.

The total stream flow, estimated present and future water requirements (without coal development), and the description of the ASRs used in this analysis are contained in Appendix E. The water flows that are shown in the tables of Appendix E are not necessarily readily available for consumption. The actual availability of this water depends upon such factors as minimum in-stream flow requirements, water quality, existing water rights, and the adjudication process of each state. In addition, the location of the water demand point within a basin may affect the water availability. Even though there may be a net water surplus in the basin as a whole, local areas within the basin may experience water shortages while others have surplus supplies.

Some of the most important limiting factors on water use in western states are legal constraints. Since water is relatively scarce in these western states, an intricate system of compacts and water laws has been developed to divide the existing water both between states and within states. This system is quite complex and subject to many interpretations of key issues [24,25,26,27,28,29]. Major issues include the extent of Indian¹ and Federal water rights,² the amount of water available for division among the states, and the ease with which water rights may be changed from one use to another. In general, water rights in the western states are governed by the doctrine of prior appropriation, in which the first water user in a basin has the first right to use the water during periods of shortage. Many of the streams in the West are already over-appropriated, or appropriated to the extent that users with new rights are not guaranteed a water supply during periods of low flow. Procedures for transferring water rights with early

priority dates vary in complexity from state to state. In many cases the rights may be transferred without excessive difficulty as long as all parties are willing [25]. However, most western states have provisions designed to protect the rights of other water users which could complicate transfer proceedings if another appropriator in the basin objects to the transfer [30].

One other consideration in the evaluation of water availability is that the calculated future flows determined by the Water Resources Council (WRC) are based on historical flows and, therefore, contain the implicit assumption that reservoir releases would continue in the same pattern as they did during the period of record upon which the total stream flows are derived. As water supply needs change, reservoir operations would likely be modified to meet these needs. Maintenance of in-stream flow requirements could also necessitate changes in current operating patterns. New reservoirs may be built in an attempt to ensure more constant water supplies for coal or other developments, although it should be noted that proposals to build new reservoirs often produce extensive opposition on environmental grounds. In addition, some existing reservoirs in the coal regions already have significant amounts of unused water storage reserved for industrial purposes. For example, the U.S. Bureau of Reclamation has approximately 650,000 acre-feet in the Yellowtail Reservoir (Big Horn Lake) adjacent to the Powder River Coal Region that are reserved for industrial options, but are not currently used [31]. Any new reservoir construction or changes in operating patterns of existing reservoirs would have the effect of distributing flows more evenly throughout the year and between surplus and dry years, although they cannot increase the long-term average water flow in the basin.

Table 5-12 summarizes the regional consumptive water requirements for each of the three production levels under the no new leasing alternative in both 1985 and 1990. These requirements were aggregated using the groupings from Table 5-11 to give the total annual requirements for the three levels in each of the watershed groupings. These requirements are presented as Table 5-13. The WRC estimates of future water flows for each watershed are combined with the data in Table 5-13 to give an estimate of the water flows with and without the requirements of coal development. These estimates are discussed later in this section.

It should be noted that the calculated future flows as determined by the WRC already include projections for water requirements needed to support future energy production. (The use of the word "quads" in the present context refers to a unit of measurement equal to 10 raised to the 15th power (10^{15})). The WRC scenarios are based on a total gross United States energy consumption level of 103.1 quads in the 1985, including imports. About 21 quads (20 percent) of this would be supplied by coal, 66 quads (64 percent) by petroleum and natural gas, and 12 quads (11 percent) by nuclear fuels, with the remainder being supplied by synthetic fuels, solar, and geothermal sources. WRC's projected water requirements

¹The Indian tribes of the Northern Great Plains have claimed prior and paramount rights to all waters which flow through, arise on, or border their reservations, based on the United States Supreme Court case, *Winters v. United States*, 207 U.S. 564 (1908). This claim and similar claims in other regions will have to be resolved in the courts.

²Reserved Federal water rights are based on a large number of complex and sometimes ambiguous statutes, treaties, constitutional provisions,

Congressional charters, and court decisions. In general terms, these documents give the Federal Government the power to exercise almost complete control over the Nation's water resources [24]. Up to this time, Federal water rights have been used only to a very limited extent. Any attempts to increase their use would be subject to extreme controversy and would probably result in extensive court litigation. Two of the Indian water rights cases mentioned above also have implications in this regard.

TABLE 5-11

(a)
COAL REGIONS AND CORRESPONDING AGGREGATED SUBREGIONS

Coal Region	ASR	Watershed
Northern, Central, and Southern Appalachian	502 plus 601	Upper Ohio and Upper Tennessee Rivers
Eastern Interior and Appalachian	505 plus 705 minus 507, 602, and 1011	Upper Mississippi and Ohio Rivers at St. Louis, Mo., but excluding the Missouri, Tennessee, and Cumberland Basins
Western Interior, Powder River, and Fort Union	1011 plus 1104	Missouri and Arkansas Rivers
Texas	1107 plus 1201, 1202, 1203, 1204, and 1205	Texas Gulf and Red River
Powder River	1004	Yellowstone River
Powder River and Fort Union	1005	Upper Missouri River
Green River-Hams Fork	1401	Green River
Green River-Hams Fork and Uinta-Southwestern Utah	1401 plus 1402	Green River and Upper Mainstem Colorado River
Green River-Hams Fork, Uinta-Southwestern Utah, and San Juan River	1403	Upper Colorado River at Lee's Ferry, Arizona
Denver-Raton Mesa	1007 plus 1102	Upper Platte and Upper Arkansas Rivers

(a) Source: Derived from Reference Number 23.



FIGURE 5-2
STREAM FLOW MONITORING POINTS

TABLE 5-12

NO NEW LEASING ALTERNATIVE
EVAPORATIVE (CONSUMPTIVE) WATER REQUIREMENTS

(1000 acre-feet per year)

COAL REGION	1985			1990		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Northern Appalachian	436.9	426.6	438.2	432.6	506.7	533.2
Central Appalachian	161.3	183.9	183.9	211.6	271.5	270.9
Southern Appalachian	228.0	309.2	305.3	226.5	340.6	346.7
Eastern Interior	412.2	429.3	453.0	457.2	478.1	458.5
Western Interior	257.4	330.3	340.3	278.8	535.9	525.4
Texas	277.4	421.4	424.4	354.6	775.3	753.1
San Juan River	27.5	29.1	59.1	68.1	62.5	64.2
Uinta- Southwestern Utah	52.5	53.3	59.1	68.1	62.5	64.2
Green River- Hams Fork	49.3	59.5	60.7	58.9	55.5	62.6
Powder River	60.1	63.3	78.8	82.3	76.6	96.0
Fort Union	54.4	47.3	101.6	82.2	121.5	135.9
Denver-Raton Mesa	46.7	58.3	65.4	68.0	87.9	79.2
Others	479.5	510.6	588.3	542.2	785.7	772.3

TABLE 5-13

NO NEW LEASING ALTERNATIVE
CONSUMPTIVE WATER REQUIREMENTS BY WATERSHED ^(a)

(1000 acre-feet per year)

WATERSHED(S)*	1985			1990		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Upper Ohio & Upper Tennessee Rivers	826	920	927	871	1120	1150
Upper Mississippi (above St. Louis) & Ohio River	1238	1349	1380	1328	1597	1609
Missouri & Arkansas Rivers	419	499	582	511	822	837
Texas Gulf & Red River	277	421	424	355	775	753
Yellowstone River	60	63	74	82	77	96
Upper Missouri River	115	111	175	165	198	232
Green River	49	60	61	59	56	63
Green River & Upper Mainstem Colorado River	102	113	120	127	118	127
Upper Colorado River at Lee's Ferry, Arizona	129	142	166	161	154	173
Upper Platte & Upper Arkansas Rivers	47	58	65	68	88	79

(a) Aggregated from Table 5-12 using regional watersheds in Table 5-11.

* See Appendix E.

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include mining, petroleum refining, and steam electric generation. No water requirements were estimated for synthetic fuels production. Table 5-14 lists the WRC estimates for each watershed grouping used in this analysis. Since the coal management program addresses only increased development of coal resources without examining total U.S. energy production, it is not possible to directly compare the water requirements projected under the Federal coal management program alternatives and those projected by the WRC (the 1985 low, medium, and high levels of development projected for the no new leasing alternative correspond to a gross coal production of about 22, 24, and 26 quads, respectively). Therefore, the WRC estimates shown in Table 5-14 are not deducted from the calculated flow shown in the tables of Appendix E or in the following analysis of water flows with and without coal development. Since the Federal coal management program would not significantly change the coal production levels used by the WRC in some regions, the following water availability analysis "double counts" the water requirements for energy development in a few regions by including water requirements for both the WRC and the coal production levels associated with the coal management program projections. Based on a comparison of Tables 5-13 and 5-14, the water requirements for the coal management program would not be vastly different from the requirements for the development of energy supplies without the program. In the western watersheds, the WRC estimates for the year 1985 generally exceed the no new leasing alternative requirements, while in the eastern watersheds, the no new leasing requirements exceed the WRC estimates. The coal production and consumption estimates account for only the portion of the total energy production supplied by coal. The major differences in water requirements are regional in nature, occurring primarily in the Texas Coal Region, where the coal management requirements are about one-third of the WRC-projected requirements for other (primarily petroleum) energy sources, and in the Appalachian and Eastern Interior Coal Regions, where the water requirements are up to almost twice those postulated by the WRC in 1985. Water requirements for the no new leasing alternative in the Green River and Upper Mainstem Colorado River basins are also slightly greater than those projected by WRC.

Impacts - No New Leasing Alternative. The total regional water requirements reflect the degree to which coal development is supported by each region. The 1985 consumptive water requirements for the no new leasing alternative high option range from a low of 59,000 acre-feet per year in the San Juan River Coal Region to a high of 453,000 acre-feet per year in the Eastern Interior Coal Region (see Table 5-12). The requirement for 588,000 acre-feet shown for other areas is due to coal consumption in nonproducing areas and is distributed throughout the remaining areas of the United States.

Based upon predicted water flow data in Table 5-15, the water supply in the Northern, Central, and Southern Appalachian Coal Regions (the Upper Ohio and Upper Tennessee River basin) is more than sufficient to support projected coal related development. The yearly requirement in 1985 for the high option (about 927 thousand acre-feet, see Table 5-12) is less than 2 percent of the extreme low flow (95 percent low flow or the flow which is exceeded during 19 out

of every 20 years, on the average) for the watershed (about 63 million acre-feet). The 20-year low flow for October is about 1.4 million acre-feet and the average monthly requirement is about 7.7 thousand acre-feet. Even under such low-flow conditions, the monthly flow is not expected to go below 1.3 million acre-feet per month. In addition, the Southern Appalachian Coal Region may be able to obtain water from the Black Warrior and Coosa River systems and the Northern Appalachian Coal Region may obtain some water from the Susquehanna River, none of which has been included in this analysis. Although estimates of water flow in 1990 are not available, it appears that the additional requirements for the no new leasing alternative (as shown in Table 5-13) would not present any significant problems at the regional level. About 80 percent of the water withdrawals in the Appalachian Regions would be consumptively used (Tables 5-10 and 5-12). The remainder (between 190 and 210 thousand acre-feet) would be discharged as waste fluid to surface water. Without strict adherence to effluent guidelines mandated by the Federal Government and the states, some local pollution problems might occur. During most of the year, however, stream flows would remain sufficiently high to reduce the pollution potential through dilution and dispersion.

The situation is similar for the water requirements of the Eastern Interior Coal Region, which is supported by the Upper Mississippi and Ohio River Basins (see Table 5-16). Since the Ohio River Basin also supports the water requirements for a large portion of the Appalachian Coal Regions, the water requirements for all three Appalachian Regions were combined with those of the Eastern Interior Coal Region in Table 5-16. This results in the presentation of a worst-case situation since at least some of the water supply for the Northern and Southern Appalachian Coal Regions would be developed from sources not included in the table. However, even this extra demand could be supplied. The 1985 annual requirement for the combined regions is estimated to be 1.4 million acre-feet for the high option. This is less than 1.2 percent of the calculated 20-year low flow of the two basins (about 121 million acre-feet). In no case would the monthly requirement exceed 10 percent of the monthly low flow. Some local problems, however, may occur where stream flow of individual rivers may not be able to support the coal mining demands. Large supplies of groundwater are available to meet these localized demands [32,33], though groundwater quality may not be adequate for some uses, such as steam conversion. High consumptive use of the water (over 80 percent) will result in relatively low effluent discharge. Some pollution problems may, however, exist in smaller streams.

The Missouri and Arkansas River Basins support the water requirements of the Western Interior, Denver-Raton Mesa, Powder River, and Fort Union Coal Regions. Table 5-17 summarizes the impact of coal development in these regions on the Missouri and Arkansas River Basins. Without any withdrawals for coal development, there is one month (August) during which water demand exceeds surface water supplies in the Arkansas River Basin. At present, this demand is met by extensive ground water mining, and by flow averaging using the numerous reservoirs contained in the region. Additional coal development would further add to these deficiencies; however, even the expected water requirements in 1990 would not cause net regional deficits in

TABLE 5-14

WATER RESOURCES COUNCIL PROJECTED CONSUMPTIVE WATER REQUIREMENTS IN 1985
(1000 acre-feet/year)

Watershed ^(a)	Fuels Mining	Petroleum Refining	Steam Electric Generation	Total ^(b)
Upper Ohio and Upper Tennessee Rivers	74	18	435	528
Upper Mississippi and Ohio Rivers	96	52	1040	1190
Missouri and Arkansas Rivers	215	73	463	751
Texas Gulf and Red Rivers	697	257	373	1330
Yellowstone River	38	6	38	82
Upper Missouri River	67	7	62	136
Green River	31	0	54	85
Green River and Upper Mainstem Colorado River	36	0	54	90
Upper Colorado River	63	0	119	182
Upper Platte and Upper Arkansas Rivers	48	8	89	146

(a) These watersheds correspond to those listed in Table 5-11.

(b) Totals may not add due to rounding.

* See Appendix E.

TABLE 5-15

PREDICTED WATER FLOW IN THE UPPER OHIO AND UPPER TENNESSEE RIVER BASINS*,
CONTAINING THE NORTHERN, CENTRAL AND SOUTHERN APPALACHIAN COAL REGIONS, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	11,500	3,340	11,431	3,271	11,423	3,263	11,423	3,263
February	13,700	5,660	13,631	5,591	13,623	5,583	13,623	5,583
March	15,800	7,260	15,731	7,191	15,723	7,183	15,723	7,183
April	12,800	6,500	12,731	6,431	12,723	6,423	12,723	6,423
May	8,900	4,010	8,831	3,941	8,823	3,933	8,823	3,933
June	6,350	2,890	6,281	2,821	6,273	2,813	6,273	2,813
July	4,540	2,220	4,471	2,151	4,463	2,143	4,463	2,143
August	3,960	1,840	3,891	1,771	3,883	1,763	3,883	1,763
September	3,160	1,520	3,091	1,451	3,083	1,443	3,083	1,443
October	3,200	1,420	3,131	1,351	3,123	1,343	3,123	1,343
November	4,640	1,780	4,571	1,711	4,563	1,703	4,563	1,703
December	8,020	2,190	7,951	2,121	7,943	2,113	7,943	2,113
Annual ^(c)	96,500	62,800	95,674	61,974	95,580	61,880	95,573	61,873

* See Appendix E.

(a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).

(b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.

(c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-16

PREDICTED WATER FLOW IN THE UPPER MISSISSIPPI AND OHIO RIVER BASINS*,
CONTAINING THE EASTERN INTERIOR AND APPALACHIAN COAL REGIONS, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	21,650	5,550	21,547	5,447	21,538	5,438	21,535	5435
February	29,250	10,850	29,147	10,747	29,138	10,738	29,135	10735
March	32,400	15,600	32,297	15,497	32,288	15,488	32,285	15485
April	34,900	21,500	34,797	21,397	34,788	21,388	34,785	21385
May	23,200	12,200	23,097	12,097	23,088	12,088	23,085	12085
June	18,100	9,690	17,997	9,587	17,988	9,578	17,985	9575
July	13,100	6,260	12,997	6,157	12,988	6,148	12,985	6145
August	7,520	3,650	7,417	3,547	7,408	3,538	7,405	3535
September	6,510	3,580	6,407	3,477	6,398	3,468	6,395	3465
October	6,580	2,110	6,477	2,007	6,468	1,998	6,465	1995
November	9,250	2,310	9,147	2,207	9,138	2,198	9,135	2195
December	13,150	3,620	13,047	3,517	13,038	3,508	13,035	3505
Annual ^(c)	214,400	121,400	213,162	120,162	213,051	120,051	213,020	214285

*ASRs 505 plus 705 minus 507, 602, and 1011. (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-17

PREDICTED WATER FLOW IN THE MISSOURI AND ARKANSAS RIVER BASINS*,
CONTAINING THE WESTERN INTERIOR, POWDER RIVER, AND FORT UNION COAL REGIONS, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	4,160	1,050	4,125	1,015	4,118	1,008	4,110	1,000
February	5,350	1,510	5,315	1,475	5,308	1,468	5,300	1,460
March	7,360	2,380	7,325	2,345	7,318	2,338	7,310	2,330
April	9,880	2,900	9,845	2,865	9,838	2,858	9,830	2,850
May	10,300	3,080	10,265	3,045	10,260	3,038	10,250	3,030
June	9,510	2,640	9,475	12,080	9,468	2,598	9,460	2,590
July	4,180	740	4,145	705	4,138	698	4,130	690
August	539	-50	504	-73	497	-92	488	-100
September	2,910	740	2,875	705	2,868	698	2,860	690
October	4,420	1,200	4,385	1,165	4,378	1,158	4,370	1,150
November	4,480	1,300	4,445	1,265	4,438	1,258	4,430	1,250
December	3,650	1,060	3,615	1,025	3,608	1,018	3,600	1,010
Annual ^(c)	66,700	22,700	66,280	22,280	66,200	22,200	66,100	22,100

*ASRs 1011 and 1104 (See Appendix E.)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

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other months. This maximum demand would equal less than 20 percent of the unused mean monthly flow in all months except August. On an annual basis, less than one percent of the average flow and less than three percent of the 20-year low flow would be required for the high option in 1985.

Consumptive use of water withdrawals for the Federal coal management program is close to 90 percent in the Missouri and Arkansas River basins. During periods of low flow, local streams may not be able to provide sufficient flow to dilute the effluent discharges to meet water quality in many local areas.

Several rivers, including the Lower Red, Sabine, Neches, Trinity, Brazos, Colorado, and Nueces Rivers can be used to support the water demands of the Texas Region. Even though the mean annual flow of these rivers (46.7 million acre-feet) is sufficient to meet the yearly 1985 water demand of 474 thousand acre-feet (high option 1985 withdrawal), as shown in Table 5-18, the 20-year monthly low flows would not be able to support the mean monthly water consumption (35,000 acre-feet) during 4 months of the year.

Increasing water consumption by up to 85 percent in 1990 would exacerbate the water deficit, though it will not increase the number of months with net water deficits. It should be noted that deficits are predicted by 1985 for low flow conditions during three months, even without increased demands for coal development. To some degree, Table 5-18 exaggerates the water deficits in the region since this table includes a large, WRC-estimated demand for energy development. Tables in this analysis do not reflect water supplies derived from groundwater. The WRC estimates that groundwater reservoirs currently supply about 7.7 million acre-feet per year to the watersheds aggregated in Table 5-18. Baker and Wall [34] report that the three principal aquifers underlying the Texas Coal Region are the Sparta, Queen City, and Carrizo-Wilcox aquifers, and that these reservoirs could supply a steady-state yield of 130, 120, and 560 thousand acre-feet per year, respectively. (In some places, these formations interfinger with the lignite deposits and may be locally removed or dewatered during surface mining.) Additionally, this region contains numerous large surface reservoirs which help distribute the water flows more evenly throughout the year. Water pollution problems similar to those indicated for the Western Interior Coal Region would likely occur in the Texas Gulf Region as well.

The Yellowstone River Basin would provide water for the coal mining and processing facilities located in the Powder River Coal Region. Table 5-19 summarizes the impacts of the Powder River Coal Region requirements on the water supply in the Yellowstone River Basin. The high development option would require one percent of the average annual flow, and about two percent of the 20-year low annual flow of the Yellowstone River. Without coal development deficiencies are expected to occur during August and September at the 95 percent low flow level. No additional months would experience net deficits due to coal production at any level, though existing deficits would be exacerbated. The monthly demand under this high option in 1985 would equal less than four percent of the unused regional flow in all months other than August and September. This demand would increase to five percent in 1990, assuming other water requirements remain constant.

Several additional constraints affect water availability in the Powder River Coal Region, some of which have implications affecting the other western regions as well. The Montana Water Use Act of 1973 amended the State of Montana water law structure to allow the designation of water reservation for maintenance of in-stream flow. In 1974, the State enacted "the Yellowstone Moratorium," suspending action on all applications for changes in beneficial use of existing water rights, as well as all applications for new water rights for the appropriation of more than 14 cfs or 14,000 acre-feet in the Yellowstone Basin. Although originally intended to extend for 3 years, the moratorium is still in effect, pending final administrative procedures by the State Water Board. During the moratorium, the State received approximately 30 applications for reservations, including one from the Montana Fish and Game Commission which requested minimum flow in 65 different reaches in the Yellowstone Basin [35]. Their largest request was for 8.2 million acre-feet per year in the lower Yellowstone, from the Powder River to the North Dakota border. This exceeds the projected flow of the Yellowstone River for both 1985 and 2000 (see Appendix E) even under average flow conditions and without the additional demands for coal development. Since neither this nor the other proposed reservations have been approved, their potential effects on future water availability cannot be determined. However, the requested Fish and Game reservation is the estimated minimum flow necessary to support aquatic biota at desirable levels of productivity. Any decrease in flow may, therefore, cause a decline in the vitality of the aquatic community. The effects of reducing the flow below the requested reservation levels are likely to be detrimental, though the degree of significance cannot presently be estimated.

As mentioned previously, the Yellowtail Reservoir has a large, presently unused storage reserved for industrial uses [31]. Use of this water in the Powder River Coal Region would require pipelines or some other form of transport. The Montana Department of Natural Resources and Conservation has an application pending to increase the dam height on the Tongue River Reservoir (in eastern Big Horn County, in the middle of the coal region) to provide more storage for both irrigation and industry [36]. This application is also pending approval by the State Water Board. Approval of the full reservation would provide about 29,000 acre-feet per year for industrial use. This application conflicts in part with the application of the Montana Fish and Game Commission.

The Yellowstone River Compact of 1950 divided the waters of the Yellowstone River and its interstate tributaries (Clarks Fork, Big Horn River, Tongue River, and Powder River) between Montana and Wyoming. The compact applied only to those waters not appropriated at that time. Further, it contained a provision specifically prohibiting export of water from the basin without the unanimous consent of all signatory states including North Dakota. Wyoming's share of this water could range from about 2.4 to 2.9 million acre-feet (mostly from the Big Horn Basin, which contains only marginal coal supplies), depending on the exact interpretation of the compact provisions. This compact could therefore affect the distribution of development within both the Powder River and Fort Union Coal Regions and could also affect the feasibility

TABLE 5-18

PREDICTED WATER FLOW IN THE LOWER RED, SABINE, NECHES, TRINITY, BRAZOS, COLORADO,
AND NUECES RIVER BASINS*, CONTAINING THE TEXAS COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	4,460	706	4,437	683	4,425	671	4,425	671
February	5,970	1,060	5,947	1,037	5,935	1,025	5,935	1,025
March	5,830	1,205	5,807	1,182	5,795	1,170	5,795	1,170
April	6,170	1,040	6,147	1,017	6,135	1,005	6,135	1,005
May	8,480	940	8,457	917	8,445	905	8,445	905
June	5,030	240	5,007	217	4,995	205	4,995	205
July	1,850	-460	1,827	-483	1,815	-495	1,815	-495
August	-879	-1,840	-902	-1,863	-914	-1,875	-914	-1,875
September	876	-2,520	853	-2,543	841	-2,555	841	-2,555
October	2,010	11	1,987	-12	1,975	-24	1,975	-24
November	2,530	185	2,507	162	2,495	150	2,495	150
December	3,650	362	3,627	339	3,615	327	3,615	327
Annual ^(c)	46,700	9,040	46,423	8,619	46,279	8,619	46,276	8,616

*ASRs 1201 1202, 1203, 1204, 1205, and 1107 (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-19

PREDICTED WATER FLOW IN THE YELLOWSTONE RIVER BASINS*,
CONTAINING THE POWDER RIVER COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	297	159	292	154	292	154	291	153
February	387	182	382	177	382	177	381	176
March	658	296	653	291	653	291	652	290
April	527	214	522	209	522	209	521	208
May	945	490	940	485	940	485	939	484
June	2,100	973	2,095	968	2,095	968	2,094	967
July	1,100	165	1,095	160	1,095	160	1,094	159
August	164	-114	159	-119	159	-119	158	-120
September	167	-62	162	-67	162	-67	161	-68
October	372	185	367	180	367	180	366	179
November	422	283	417	278	417	278	416	277
December	315	188	310	183	310	183	309	182
Annual ^(c)	7,430	3,670	7,370	3,610	7,367	3,607	7,356	3,596

*ASR 1004 (See Appendix E)

(a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).

(b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.

(c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

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of coal slurry pipelines, though they might be allowable if supplied by groundwater.

Groundwater is available in the Powder River Coal Region both from shallow aquifers (ranging in depth to several thousand feet) and from the deeper Madison aquifer system. It has been estimated that large diameter wells drilled to depths of 1,000 to 5,000 feet and open to all aquifers through which they pass could yield up to 500 gpm [37]. However, available information is not sufficient to determine the ability of the shallow aquifers to support large well fields at this rate without causing excessive drawdowns and local depletions. In addition, the mixing of overlying aquifers could have adverse impacts such as water quality deterioration or the draining of upper aquifers into lower systems. Due to mutual well interference and low aquifer permeabilities, well fields producing significant amounts of groundwater would have to spread out over tens of square miles. Even so, it is possible that withdrawal rates on the order of 20,000 acre-feet per year from one well field would greatly exceed the local recharge and result in large declines of the compressed surface [37].

The Madison aquifer system has lately been the subject of much interest and is currently being studied by USGS to determine its potential as a water source for coal development in the Powder River Basin. Several wells in the Madison System have produced initial flows well in excess of 1,000 gpm. However, preliminary indications are that this system may be a high pressure, low yield aquifer, with a relatively low primary porosity, and very high piezometric pressures. The high pressure would produce a large initial flow which would drop off rapidly after the water near the well is depleted. The steady state yield would then be controlled by the low porosity of the bulk rock. Potential for high yield wells does exist in areas of secondary porosity enrichment, where tectonically-induced lineations and zones of weaknesses could provide low-resistance paths for water movement. Wells at the intersections of two or more lineations might produce quite high sustained yields. These concepts are presently being tested by the U.S. Geological Survey [38].

One concern that should be considered when planning to mine groundwater is the tendency of groundwater systems to maintain a natural equilibrium in which groundwater recharge is balanced over the long term by groundwater discharge to streams and springs. Such discharges are the source of the streamflow of perennial streams during periods of low rainfall. If groundwater systems were mined at rates equal to or exceeding the rate of recharge, natural discharge points would eventually begin to dry up. This effect would be more important for the shallower aquifers. Since the Madison aquifer is quite deep, withdrawals should not have much effect on streams within the Powder River Basin, although they may affect streamflow in the Big Horn Mountains and Black Hills, where the Madison aquifer outcrops and receives its recharge.

The Fort Union Coal Region has the advantage of being able to draw on the supplies of the upper mainstream of the Missouri River as well as water from the Yellowstone River system. Also, two large reservoirs, Fort Peck Lake and Lake Sakakawea, located on the Missouri River have combined active storage in excess of 24 million acre-feet [37] and can help distribute the water flow more evenly through time, saving the peak flows for release during dry periods. With

proper planning, the reservoirs of the region would be able to mitigate low-flow problems in the future. In such cases, impacts could occur on the aquatic biota of the reservoirs during irregular fluctuations of the water level. Table 5-20 indicates that up to 14 percent of the annual average flow for this river basin could be required. Up to 38 percent of the 20-year low annual supply would be required in 1985. The average monthly requirement for the high option (about 15 thousand acre-feet) amounts to 10.5 percent of the lowest monthly low flow (February). As previously discussed, these calculations apply only to the net water balance in the basin. Shortages could occur locally that would not be reflected by the stream flows out of the basin. Additionally, water rights and other legal considerations could affect actual water availability.

The Upper Colorado River Basin would be the primary source of supply for the Green River-Hams Fork, Uinta-Southwestern Utah, and San Juan River Coal Regions. The supply and demand estimates for this basin are summarized in Table 5-21. According to the Colorado River Compact of 1922, the states of the Upper Colorado Basin must supply an average flow over any consecutive 10-year period of 7.5 million acre-feet per year to the Lower Basin at Lee's Ferry, Arizona. In addition, the states are obligated to support the U.S. agreement to release 1.5 million acre-feet per year to Mexico, though the exact extent of their obligation is a point of dispute between the Upper and Lower Basins. Assuming the Upper Basin states contribute one half of the water for Mexico (a maximum case), they would be required to release a mean flow of 8.25 million acre-feet per year to the Lower Basin. The estimated mean total stream flow for the Upper Colorado Basin is 13.93 million acre-feet per year (including evaporation, see Appendix E). Therefore, the amount of water available for use in the Upper Colorado Basin averages at most 5.68 million acre-feet per year. The estimated consumptive requirement in the basin by the year 2000 is nearly 4 million acre-feet. Based on a supply of 5.7 million acre-feet, a maximum of approximately 1.7 million acre-feet would remain for additional development.

The projected consumptive water requirement for the no new leasing alternative in all three coal regions in the Upper Colorado basin is 166 thousand acre-feet per year in 1985, and 173 thousand acre-feet per year in 1990. As discussed previously, the projected water flows (shown in Table 5-21) include the WRC estimates of energy-related water requirements shown in Table 5-14. The calculated flows for the Upper Colorado Basin, therefore, already account for an estimated consumption of 182 thousand acre-feet per year, of which 63 thousand acre-feet is for fuels mining (coal, oil, gas, uranium, and oil shale). The extent to which this demand would be replaced by a Federal coal management program is not known. However, it is likely that the need for the WRC-projected energy production levels would be significantly decreased by the implementation of the preferred coal management program. As a result, the calculations shown in Table 5-21 (as well as similar tables) probably exaggerate the water demands that would occur in the basin, double counting requirements for energy production.

During low-flow periods the Upper Basin may not be able to support its own demands without releasing any water to the Lower Basin. Projected demands during three months

TABLE 5-20

PREDICTED WATER FLOW IN THE UPPER MISSOURI RIVER BASIN*,
CONTAINING THE POWDER RIVER AND FORT UNION COAL REGIONS, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	621	275	611	265	612	266	606	260
February	518	143	508	133	509	134	503	128
March	777	281	767	271	768	282	762	266
April	1,225	466	1,215	456	1,216	457	1,210	451
May	1,361	531	1,351	521	1,352	522	1,346	516
June	1,054	292	1,044	282	1,045	283	1,039	277
July	1,046	378	1,036	368	1,037	369	1,031	363
August	1,064	318	1,054	108	1,055	109	1,049	103
September	1,274	556	1,264	546	1,265	547	1,259	541
October	1,462	618	1,452	608	1,453	609	1,447	603
November	1,454	465	1,444	455	1,445	456	1,439	450
December	729	339	719	329	720	330	714	324
Annual ^(c)	12,600	4,660	12,486	4,546	12,489	4,549	12,425	4,485

*ASR 1005 (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-21

PREDICTED WATER FLOW IN THE UPPER COLORADO RIVER BASIN*,
CONTAINING THE GREEN RIVER-HAMS FORK, UINTA-SOUTHWESTERN UTAH, AND SAN JUAN RIVER COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	712	136	708	132	707	131	707	131
February	744	477	740	473	739	472	739	472
March	778	342	774	338	773	337	773	337
April	1,235	176	1,231	172	1,230	171	1,230	171
May	1,232	-114	1,228	-118	1,227	-119	1,227	-119
June	1,157	16	1,153	12	1,152	11	1,152	11
July	842	14	838	10	837	9	837	9
August	720	-105	716	-109	715	-110	715	-110
September	729	-54	725	-59	724	-59	724	-59
October	659	131	655	127	654	126	654	126
November	752	166	748	162	747	161	747	161
December	777	145	773	141	772	140	772	140
Annual ^(c)	10,340	3,510	10,291	3,461	10,280	3,451	10,279	3,449

*ASR 1403 (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

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would exceed supply under the low flow conditions even without additional coal requirements. Two other months would exhibit near negligible flow under the same conditions. Maximum coal development would increase these deficits by 13,800 acre-feet per month in 1985.

Several large reservoirs and numerous smaller ones are currently in operation in the Upper Colorado Basin. The Flaming Gorge Reservoir is located in the Green River-Hams Fork Coal Region and its releases affect stream flow in the northern portion of the Uinta-Southwestern Utah Coal Region. Its active storage is about 3.7 million acre-feet. The Blue Mesa Reservoir, just east of the Uinta-Southwestern Utah Coal Region, has an active storage of 830,000 acre-feet. The San Juan River Coal Region contains the Navajo Reservoir, with an active storage of about 1.7 million acre-feet, much of which is committed to a Navajo Indian irrigation project [39]. Under appropriate circumstances, some of the water demands for coal development could be supplied from these reservoirs, even though they distribute flows only and, due to evaporation, cannot increase gross water supply.

Groundwater is available in the Upper Colorado Basin (Green River-Hams Fork and Uinta-Southwestern Utah Coal Regions), though not to the extent it is in the Eastern Interior and Appalachian Coal Regions. It has been estimated that the Upper Colorado Basin contains between 50 and 115 million acre-feet of recoverable groundwater in storage in the upper 100 feet of saturated rocks, with a recharge rate of about 4 million acre-feet per year [40]. However, not all of this is usable. Over long periods of time, the natural groundwater discharge tends to equal the natural groundwater recharge. Consequently, any long-term diversion of groundwater would cause a proportionate decrease in the groundwater discharge, such as reducing the groundwater influx to streams. In addition, although the total volume of groundwater in storage is rather large, about 85 percent of it occurs in sedimentary rocks characterized by low permeability which yield water to wells quite slowly. Well yields in the vicinity of the San Juan River Coal Region rarely exceed 50 gallons per minute. In places, especially around the San Juan River Coal Region, groundwater levels may be more than 1,000 feet below the land surface [40]. In some areas of Arizona and New Mexico, notably near urban areas south of the San Juan River Coal Region (such as Phoenix and Tucson, Arizona), groundwater withdrawals are causing large drawdowns of the water table. It is estimated that the groundwater overdraft in Arizona is about 2 million acre-feet per year [41]. Such overdrafts can lead to land subsidence as the pore spaces in the rock which were formerly filled with water collapse. It may be concluded that, although groundwater supplies may be sufficient to support individual plants, depending on their location, groundwater reservoirs are not in themselves sufficient to supply the additional water to support the commitment to the Lower Basin.

The 1985 discharge of about 25,000 acre-feet of effluent from the Green River-Hams Fork, Uinta-Southwestern Utah, and San Juan River Coal Regions in the Colorado River Basin may result in some local water pollution problems, since the Colorado River Basin is already characterized by high salinity. Potential problems are similar to those which are discussed for the other western regions.

The water requirements for the Green River-Hams Fork and Uinta-Southwestern Utah Coal Regions can also be examined based on smaller sub-basins contained within the Upper Colorado River Basin. The Green River-Hams Fork Coal Region is contained entirely within the Green River Basin (ASR 1401). The Uinta-Southwestern Utah Coal Region spans the lower part of the Green River Basin, as well as a large fraction of the Upper Colorado River Mainstem (ASR 1402). Table 5-22 compares water supply data for the Green River with the water requirements for coal development in the Green River-Hams Fork Coal Region alone.

Table 5-23 compares the combined supply data for the Green and Upper Colorado Mainstem Systems with the requirements for coal development in both the Green River-Hams Fork and the Uinta-Southwestern Utah Coal Regions. The extent to which these sub-basins would be required to support the Colorado River Compact and associated commitments is not clear. Although the water in the Upper Colorado Basin as a whole is divided between the states, it is not divided according to watershed, so neither coal region's share of the commitment can readily be estimated. However, the total mean annual stream flow of the Green River alone (as shown in Appendix K) constitutes 38 percent of the total flow in the Upper Colorado Basin, and the combined flows of the Upper Colorado Mainstem and Green River constitute 84 percent of the total mean flow of the Upper Colorado River at Lee's Ferry, Arizona. It can therefore be assumed that the Green River-Hams Fork and Uinta-Southwestern Utah Coal Regions' share of Upper Basin commitments are significant. In addition, the water rights to most free-flowing water in the Upper Colorado Basin are already allocated and could have to be transferred in order to support additional development with assured water supplies.

Table 5-22 summarizes the impact of coal development in the Green River-Hams Fork Coal Region on the predicted water flow in the Green River Basin. Coal development in this region would require up to 61 thousand acre-feet of water annually by 1985, and 63 thousand acre-feet annually by 1990. Even at the high option, this is less than 2 percent of the mean annual water flow and less than 4 percent of the 20-year low flow in the Green River. On a monthly low-flow basis, it is estimated that water demand during one month (August) would exceed supply by the year 1985 even without coal development. No additional months would experience net deficits as a result of coal development at any of the options presented here, and except for that one month, the high option water consumption would be less than 15 percent of the unused stream flow during any monthly low flow.

Table 5-23 summarizes the impact of coal development in both the Uinta-Southwestern Utah and Green River-Hams Fork Coal Regions on the projected combined waterflows in the Upper Colorado Mainstem and Green River. Coal development in both of the aforementioned regions would require up to 120 thousand acre-feet of water each year by 1985, and up to 127 thousand acre-feet by 1990. At the high option level, this is about 1.3 and 3.0 percent of the mean and 20-year low annual flows (respectively) of the combined river systems. Even on a monthly low-flow basis, it is estimated that the water flow in the basin would be sufficient to supply the water requirements for both coal development and all other

TABLE 5-22

PREDICTED WATER FLOW IN THE GREEN RIVER BASIN*,
CONTAINING THE GREEN RIVER-HAMS FORK COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	183	68	175	60	174	59	173	58
February	232	97	224	89	223	88	222	87
March	260	103	252	95	251	94	250	93
April	424	133	116	125	415	124	414	123
May	738	360	730	352	729	351	728	350
June	873	333	865	325	864	324	863	323
July	351	72	343	64	342	63	341	62
August	77	-41	69	-49	68	-50	67	-51
September	115	33	107	25	106	24	105	23
October	182	60	174	52	173	51	172	50
November	181	82	173	74	172	73	171	72
December	177	60	169	52	168	51	167	50
Annual ^(c)	3,790	1,630	3,688	1,528	3,677	1,517	3,670	1,510

*ASR 1401 (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-23

PREDICTED WATER FLOW IN THE UPPER COLORADO MAINSTREAM AND GREEN RIVER BASINS*,
CONTAINING THE GREEN RIVER-HAMS FORK AND UINTA-SOUTHWESTERN UTAH COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	351	218	340	207	339	206	337	204
February	410	260	399	249	398	248	396	246
March	467	288	456	277	455	276	453	274
April	936	533	925	522	924	521	922	519
May	1,960	1,370	1,949	1,359	1,948	1,358	1,946	1,356
June	2,260	1,450	2,249	1,439	2,248	1,438	2,246	1,436
July	877	460	866	449	865	448	863	446
August	313	140	302	129	301	128	299	126
September	262	135	251	124	250	123	248	121
October	408	247	397	236	396	235	394	233
November	394	277	383	266	382	265	380	263
December	361	222	350	211	349	210	347	208
Annual ^(c)	9,050	3,930	8,920	3,801	8,908	3,788	8,884	3,764

*ASRs 1401 and 1402 (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements; water quality; and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

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users by drawing heavily on the Upper Colorado Mainstem during periods of drought. Coal development would require up to about 7.5 percent of the lowest 20-year monthly flow in 1985.

However, in order to obtain sufficient and reliable water supplies to support normal regional development, the compact commitments, and coal developments in the Upper Colorado Basin, it would probably be necessary to obtain existing water rights and transfer them to industrial purposes. Such procedures would be significantly affected by the disposition of existing and future court cases involving the extent of Indian and Federal water rights. The ability to acquire and transfer existing water rights is governed by state law and varies with each state in the region. Although such transfers may be somewhat complicated, they are generally possible in all the Upper Basin states [30]. Such transfers would decrease the amount of water used for other purposes, notably irrigation, and could have considerable socioeconomic impacts.

The Upper Platte and Upper Arkansas River Basins would support any future development in the Denver-Raton Mesa Coal Region. Coal development at the high option level would require 65 and 79 thousand acre-feet of water per year in 1985 and 1990, respectively. Table 5-24 indicates that even without additional demands for coal development, the projected monthly mean flow during July and August would not meet the normal water requirements of the two basins. At the low flow level, net deficiencies would occur during September as well, and local deficiencies would probably occur during other months. As shown in Table 5-14, the water use projections, on which the results shown in Table 5-24 are based, already include 146 thousand acre-feet for energy-related requirements. Since this exceeds the estimated requirements for the no new leasing alternative it is quite possible that Table 5-24 over-estimates the shortages. However, even without considering the additional demands, water shortages would still be significant.

The water shortages of this region are compounded by its rapid rate of urbanization. In a situation similar to that discussed for the Upper Colorado and Upper Missouri River Basins, virtually all dependable natural water supplies of the region were claimed long ago under the doctrine of prior appropriation [42]. Rapid urbanization on the eastern slopes of the front range of the Rocky Mountains has resulted in intense competition for existing water rights and has led to several condemnation proceedings being brought against irrigation companies to secure agricultural water rights for municipal use [43]. The prospects of developing new water rights for coal development in the prevailing political climate of this region are not good.

In many cases, coal seams are associated with or located below groundwater aquifer systems. A notable case is in the Fort Union, Powder River, and Green River-Hams Fork Coal Regions where the Wasatch and Fort Union Formations, which contain much of the coal, are aquifers themselves. Additionally, the three major aquifers underlying the Texas Coal Region are interfingering with the lignite deposits. In order to mine these formations, it would often be necessary to dewater them (at least locally). This water can be applied as process water and for other uses at the site and, in some cases, may satisfy a large portion of the water requirement.

However, extensive dewatering of such aquifers could cause shallow wells located nearby to go dry.

Impacts of Other Alternatives. Table 5-25 presents the relative water consumption of the other alternatives, as compared to the no new leasing alternative. The information is presented in acre-feet per year, and aggregated in the same watersheds used in the preceding analysis. In order to compare these estimates with the expected water flows in Tables 5-15 through 5-24, the numbers must be divided by 12 to yield monthly consumption. Even considering the annual values, most of the differences are small, and many are almost negligible.

Preferred Program. In 1985, the consumptive water requirements for the low option of the preferred program are practically indistinguishable from those of the low option of the no new leasing alternative. The only difference in an additional demand for about 550 acre-feet per month in the Fort Union Coal Region. This could result in a slight increase in local shortages in that region during times of drought. However, due to the large reservoir storage capacity in the region, the significance of this increased demand is minor.

Similarly, all other options for this alternative in both 1985 and 1990 would not greatly increase the water demands over those discussed with respect to the no new leasing alternative. Except for a few regions in the case of the 1990 high option, consumptive water demands would not increase more than 2,000 acre-feet per month.

In 1990 the high option for the preferred program would increase the consumptive water demand in the Mississippi, Ohio, and Tennessee River Basins by a total of 544 thousand acre-feet per year. This increased demand can be supplied relatively easily in the Appalachian, Eastern Interior, and Western Interior Coal Regions, although the associated effluents could somewhat decrease local water quality. The increased demand of about 10,000 acre-feet per month in the Western Interior Coal Region for this option represents a 13 percent increase over the no new leasing alternative, and could exacerbate the supply problems in that region accordingly. Similarly, the 36 percent increase projected for the coal regions of the Upper Colorado River Basin (Green River-Hams Fork and Uinta-Southwestern Utah) would serve to increase competition for water. Although, subject to the constraints discussed previously, this increase could be met on an annual basis without violating any of the regional water compacts. Local shortages would probably be an important constraint on this option.

PRLAs Only Alternative. In 1985, the water requirements for this alternative would decrease water consumption by as much as 2,000 acre-feet per month (relative to the no new leasing alternative) in six of the watersheds addressed in this analysis. Demands in four of the western watersheds would increase by less than 1,000 acre-feet per month. In 1990, relative water consumption would decrease by as much as 1,000 acre-feet per month in six of the watersheds addressed in this analysis, while increases in the others would reach only about 1,250 acre-feet per month. The effects of this alternative would, therefore, closely parallel those discussed for the no new leasing alternative.

TABLE 5-24

PREDICTED WATER FLOW IN THE UPPER ARKANSAS AND UPPER PLATTE RIVER BASINS*,
CONTAINING THE DENVER-RATON MESA COAL REGION, 1985

(1000s of acre-feet)

PERIOD	CALCULATED FLOW ^(a) WITH NORMAL DEVELOPMENT ^(b)		CALCULATED FLOW ^(a) BASED ON THE NO NEW LEASING ALTERNATIVE					
			LOW		MEDIUM		HIGH	
	MEAN	95%	MEAN	95%	MEAN	95%	MEAN	95%
January	94	52	90	48	89	47	89	47
February	110	63	106	59	105	58	105	58
March	123	71	119	67	118	66	118	66
April	103	47	99	43	98	42	98	42
May	183	75	179	71	178	70	178	70
June	290	127	286	123	285	122	285	122
July	-35	-100	-39	-104	-40	-105	-40	-105
August	-109	-157	-113	-161	-114	-162	-114	-162
September	18	-42	14	-46	13	-47	13	-47
October	118	72	114	68	113	67	113	67
November	108	65	104	61	103	60	103	60
December	99	63	95	59	94	58	94	58
Annual ^(c)	1,100	1,000	1,053	953	1,042	942	1,035	935

*ASRs 1007 and 1102. (See Appendix E)

- (a) Calculated flow is the difference between the water entering and the total water depletions in the watershed(s) that contain the region. It is the estimated amount of water that would flow out of the basin as measured at the point of discharge. Negative values indicate water deficits which would necessitate at least temporary reduction in upstream consumption. Positive values do not necessarily imply that the water is available for use, since water availability also depends on such factors as minimum in-stream requirements, water quality, and water law as determined by each state and by compacts between the states (see text).
- (b) Normal Development is the projected flow adjusted for 1985 average year consumptive requirements as postulated by WRC.
- (c) Annual totals may not equal the sum of the individual months due to accumulated round-off error. The annual 95 percent flow does not equal the sum of the monthly 95 percent flows.

Source: Adapted from Reference Number 23.

TABLE 5-25

WATER CONSUMPTION (EVAPORATIVE)
IMPACTS, COMPARISON OF ALTERNATIVES

(1000 ac-ft/yr)

WATERSHED	Program Alternatives										
	NO NEW LEASING ^(a)			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1985 PROJECTIONS											
Upper Ohio & Upper Tenn.	826.4	919.7	927.4	0	-7.2	-1.8	-21.7	-22.7	-24.0	0	-22.9
Upper Miss. & Ohio Rivers	1,238.4	1,349.0	1,380.4	0	-7.9	0.2	-22.0	-23.8	-22.9	0	-25.4
Missouri & Arkansas Rivers	418.6	499.2	591.8	6.6	-3.3	28.8	-8.2	-6.7	-14.3	0	-21.4
Texas Gulf & Red River	277.4	421.4	424.4	0.3	1.9	18.4	-3.4	-1.8	-6.3	0	9.5
Yellowstone River	60.1	63.3	73.8	0	0	2.4	-0.02	0.02	2.6	0	-2.2
Upper Missouri River	114.5	110.6	175.4	6.6	7.1	3.4	7.1	7.2	16.8	0	9.2
Green River	49.3	59.5	60.7	0	1.7	2.8	-0.4	0.2	5.2	0	0.4
Green River & Upper Colo.	101.8	112.8	119.8	0	3.2	3.9	0.2	0.8	7.4	0	0.04
Upper Colo. at Lee's Ferry	129.3	141.9	165.9	0	3.2	3.8	0.4	-0.6	7.6	0	0.4
Upper Platte & Upper Ark.	46.7	58.3	65.4	0	2.9	1.4	2.7	2.7	5.7	0	-0.4
1990 PROJECTIONS											
Upper Ohio & Upper Tenn.	807.7	1,118.8	1,150.8	8.4	0.3	422.1	15.7	-2.2	3.7	-1.0	7.6
Upper Miss. & Ohio Rivers	1,327.9	1,596.9	1,609.3	8.9	-0.3	544.4	15.5	-5.7	3.6	-0.3	5.1
Missouri & Arkansas Rivers	511.3	821.9	836.5	0.9	4.6	112.4	-13.9	-11.0	32.7	3.5	-35.6
Texas Gulf & Red River	354.6	775.3	753.1	-1.0	-1.6	73.0	-12.6	-10.7	-13.7	-5.8	-10.6
Yellowstone River	82.3	76.6	96.0	0.3	5.6	15.8	2.6	-0.4	9.4	5.4	-4.1
Upper Missouri River	164.5	198.1	231.9	0.3	5.0	9.9	4.7	2.9	17.9	-10.6	0.7
Green River	58.9	55.5	62.6	0.5	1.4	5.9	-4.0	-4.2	4.4	2.9	-6.3
Green River & Upper Colo.	127.0	118.0	126.8	2.3	1.5	27.2	-7.4	-7.1	5.5	2.4	-8.9
Upper Colo. at Lee's Ferry	161.2	153.6	173.1	2.9	1.2	62.0	-7.6	-7.5	5.6	-4.1	-9.4
Upper Platte & Upper Ark.	68.0	87.9	79.2	0	0	21.6	-2.1	-1.6	2.4	2.6	-6.3

(a) Represents absolute water consumption under the no new leasing alternative production projections. All other columns represent changes from the no new leasing base case.

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Short-term Leasing Only Alternative. The 1985 consumptive water requirements for this alternative are nearly identical to those of the PRLAs only alternative. The 1990 water consumption would decrease relative to the no new leasing alternative in all but one watershed (Upper Missouri River) by less than 1,000 acre-feet per month. This alternative thus represents a slight improvement in most watersheds relative to the impacts described previously for the no new leasing alternative. However, due to the small differences, the improvements would be minor.

Meet Industry Needs Alternative. The net effect of this alternative would be to slightly increase western water consumption (relative to the no new leasing alternative) in both 1985 and 1990, the maximum increase would be about 3,000 acre-feet per month in the Missouri and Arkansas River Basins (Western Interior, Denver-Raton-Mesa and Uinta-Southwestern Utah Coal Regions). Water demand in the East would be less than that of the no new leasing alternative in 1985, and greater in 1990. Water shortages and pollution problems in the West would be slightly increased by this alternative, relative to those discussed previously.

Meet DOE Targets Alternative. The 1985 water demands for this alternative are identical to those of the no new leasing alternative. The 1990 demands differ by less than 500 acre-feet per month in all watersheds except the Upper Missouri (Western Interior Coal Region), which decreases by about 900 acre-feet per month. Thus, the impacts of this alternative would be very close to those of the no new leasing alternative. Shortages would be somewhat exacerbated in the Yellowstone, Green, Upper Colorado Mainstem, Upper Platte, and Upper Arkansas River Basins in 1990.

State Determination of Leasing Levels Alternative. The results of this alternative would be to decrease 1985 water consumption in the Appalachian, and Eastern and Western Interior Regions, and increase consumption in the Fort Union and Texas Regions, relative to the no new leasing alternative. Changes in these regions would be less than 2,000 acre-feet per month, while consumption in other regions would be changed by less than 2,000 acre-feet per year. The 1990 demands for this alternative would be slightly greater than those of the no new leasing alternative in the Appalachian and Fort Union Regions, and less in all others. The reservoirs of the Texas and Fort Union Regions should be sufficient to supply the additional demands in both years, though local shortages may occur. More extensive aquifer disruption in these regions may create additional problems. Otherwise, the impacts of this alternative would be similar to those discussed previously. The water availability problems projected for the Western Interior Region, and to a lesser extent in the Denver-Raton Mesa Region, would be somewhat reduced.

5.2.2.7 Air Quality. This section addresses air emissions in a manner which allows a comparison of the region by region totals, as well as a comparison of the emissions associated with the Federal coal management program alternatives against the no new leasing base case. This section begins with a discussion of the sources of air emissions associated with the entire coal cycle. Next, the legislative status of the control of air emissions is addressed. Finally, the data associated with total emissions

for each coal region and for each alternative is presented and discussed.

The regional emissions for each alternative represent the aggregated emissions from coal mining, transportation, and conversion and utilization. Gaseous streams, composed primarily of carbon dioxide (CO₂), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), and particulate matter, would be emitted to the environment because of coal development even though best available emission control technologies (BACT) were employed and air quality standards were enforced. Hydrocarbons (HC), carbon monoxide (CO), and trace elements are also emitted, although in smaller quantities. Coal conversion and utilization would contribute the largest single amount to the totals; however, significant amounts of particulates would be contributed by coal mining.

The aggregated emissions do not directly represent measures of air quality degradation. Models of varying degrees of sophistication are available that convert, under specified circumstances, the point or area source emissions into estimates of ambient air concentrations. The use of these models requires detailed information regarding the nature of the source as well as meteorological and geographic characteristics of the surrounding area. The alternatives for a Federal coal management program cannot be compared for relative air quality degradation using this technique because of a lack of specificity in this environmental impact statement. A comparison of the total emissions for each alternative is the most meaningful measure of relative air quality impact available.

Potential Air Quality Impacts. In estimating the total dust emissions from a coal mine, it is preferable to identify the dust-producing activities present and estimate emissions from each activity separately rather than to use a single emission factor for the entire mine. This allows direct determination of the major emission sources and their contribution to the overall emissions from the mine. Therefore, those operations most requiring control can be isolated and examined from the perspective of total emissions from the mine.

Potential sources of dust associated with coal mines are as follows:

- Haul roads
- Access roads
- Topsoil removal
- Overburden removal
- Reclamation
- Drilling
- Blasting
- Shovel/truck loading
- Transfer and conveying
- Front-end loading
- Truck dumping
- Open storage
- Coal crushing (after truck dumping)
- Coal cleaning
- Train loading
- Waste disposal
- Fly-ash dump at mine mouth plants
- Coal fires
- Wind erosion of exposed areas

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These sources are not always noticeable at every mine site. Only the transfer, conveying, and access road sources are normally found at underground mines, for example. Recent studies have shown that of the sources listed above, haul roads and access roads are most often the largest contributors to ambient particulate concentrations at and near the mine sites [44]. Other major sources of particulates are wind erosion from exposed areas and topsoil and overburden removal.

The impact of mining operations on existing particulate air quality at and in the vicinity of an active mine would depend on a number of variables: climatology, type of dust-producing operations, and size of the mine. Any one of these factors could greatly add to or reduce emissions from a mine site. For example, a small underground mine could contribute greatly to the ambient particulate concentration in the surrounding area because of an extremely long unpaved access road leading to the mine which mine employees travel every day.

The impacts on air quality would be greatest at the mine site where generation of airborne particulates would take place and at areas closely surrounding the mine site. Air quality impacts from mining operations generally would decrease markedly with respect to distance from the site.

The addition of particulates to the atmosphere could also reduce visibility at the mine site and in surrounding areas. Table 5-26 presents four examples of visibility reduction that could happen as a result of increased atmospheric total suspended particulates.

Another air pollution source at coal mines is exhaust emissions from employees' motor vehicles and diesel-powered haul trucks and equipment. The major gaseous emissions from these sources are carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides and water vapor. The amount of these pollutants generated at even the larger coal mines would not be significant. Recent studies of the impact of vehicle emissions associated with western coal mines conclude that the probable range of impacts would be insignificant [16].

Air pollutants associated with transportation of coal by rail or barge would result primarily from coal cars and barges and from the exhaust of train and tug engines. Estimates of wind blown coal dust range from 0.2 to 2 percent of the volume of coal transported [2]. These estimates assume that the coal is transported dry. If transported wet, dust emissions could be reduced to negligible amounts.

Any large-scale construction activity would generate essentially the same types of air pollutants. The major emissions would include fugitive dust, exhausts from motor vehicles and construction equipment (primarily carbon dioxide, carbon monoxide, hydrocarbons, and nitrogen oxides, and water vapor), and smoke from the burning of cleared vegetation. The magnitude of the emissions would depend on the size of the construction area, the method of construction, the project duration, the type of terrain, and the type of control measures employed. In topographically low areas in narrow, steep-sided valleys, where the build-up of polluted air would be greater than in surrounding areas, concentrations of nitrogen oxides from construction equipment could exceed the National Ambient Air Quality Secondary Standards. The actual concentrations would depend upon such factors as wind and temperature

conditions, atmospheric mixing conditions, pollutant production rates, and duration of operations.

Coal combustion to generate steam and electric power for internal use by synthetic fuel plants and electric power plants would release both gaseous and solid (particulate matter) pollutants. The chemical and physical characteristics of the gases leaving the boiler primarily are a function of the fuel composition and boiler design. The major gaseous pollutants produced during fossil fuel combustion would be sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, and aldehydes. The particulate matter produced during combustion would leave the boiler as fly ash.

Sulfur oxides would be produced in the greatest quantity during coal combustion. About 95 percent of the sulfur in the coal would be converted to gaseous sulfur oxides; the balance would remain in the fly and bottom ash, or slag. For coal with a sulfur content of 2 percent (by weight), approximately 76 pounds of sulfur oxides (as sulfur dioxide) would be produced for each ton of coal combusted.

Nitrogen oxides are produced from high temperature reactions of nitrogen and oxygen present in the combustion atmosphere and the combustion of nitrogen-containing compounds in the fuel. The concentration of nitrogen oxides in the exhaust during coal combustion would be affected by the amount of nitrogen in the coal, the air-to-fuel ratio, and the time and temperature profile of the combustion gases as they pass through the boiler. Dry bottom pulverized coal-fired units would emit about 18 pounds of nitrogen oxides for each ton of coal fired, wet bottom pulverized coal units (operating at higher temperatures) would emit 30 pounds, and wet bottom cyclone units would emit 55 pounds [45].

Other gaseous pollutants such as carbon monoxide, hydrocarbons, and aldehydes would occur in relatively small quantities during fuel combustion. They would result from incomplete combustion of the organic portion of the coal. Careful control of excess air rates, the use of high combustion temperature, and provisions for intimate fuel-air contact could minimize these emissions.

The particulates in the exhaust gases of coal combustion primarily would be comprised of silica, alumina, and iron present in the inorganic portion of the coal or ash. The size distribution of particles leaving the unit would primarily be a function of unit type. Particulates from a pulverized coal unit would generally be larger than those from a cyclone unit. Particle size distribution would vary from one boiler to the next. These variations are important as they affect the formation of fine particulates that are not only more difficult to control but also considered a greater risk to health.

In addition to the major gaseous and particulate pollutants of concern, coal combustion would also result in emissions of a variety of toxic trace elements which, in sufficient quantity, could cause adverse environmental and health effects. During combustion, these trace elements could vaporize to exit the boiler in a gaseous state, or they could form particulates that would be entrained in the exhaust. High efficiency particulate control could greatly reduce these emissions. However, despite the low concentrations of these pollutants in coal and the high efficiency of present particulate control systems, the sheer volume of coal consumed in the United States makes coal combustion a major air emission source of these pollutants.

TABLE 5-26

EXPECTED VISIBILITY AT FOUR DIFFERENT TOTAL
SUSPENDED PARTICULATE CONCENTRATIONS(a)

EXAMPLE	BACKGROUND(b) TSP CONCENTRATION ($\mu\text{g}/\text{m}^3$)	BACKGROUND(c) VISIBILITY (miles)	ADDITIONAL(d) PARTICULATES FROM THE MINE ($\mu\text{g}/\text{m}^3$)	RESULTANT(e) AMBIENT CONCENTRATION ($\mu\text{g}/\text{m}^3$)	RESULTANT(f) VISIBILITY (miles)	REDUCTION(g) IN AVERAGE VISIBILITY (miles)
1	25	45	5	30	40	5
2	25	45	15	40	32	13
3	25	45	30	55	25	20
4	25	45	60	85	18	27

- (a) Expected visibility for the hypothetical situations presented in this table were calculated from the formula presented in Reference Number 77.
- (b) Represents a hypothetical annual average ambient particulate concentration that would exist without the mining activity.
- (c) Represents a hypothetical annual average visibility that would exist without the mining activity.
- (d) That additional portion of the ambient particulate concentration that would be contributed to the TSP as a result of mining activity. Note that the higher contributions such as, 60 and 30 $\mu\text{g}/\text{m}^3$, would normally occur in very close proximity to the mine site.
- (e) The TSP concentration that would result from the background concentration plus the contribution from the mining activity.
- (f) The average visibility that would result from the resultant ambient concentration.
- (g) The reduction in visibility that is directly attributable to the additional particulates from the mining activity.

REGIONAL IMPACTS

The Environmental Protection Agency [45] has estimated the average trace element emissions associated with coal combustion in domestic utility boilers. These estimates and the assumed emission factors are presented in Table 5-27.

In general, because of the dispersion of coal combustion throughout the United States, air concentrations of trace elements from coal firing should not accumulate to levels commensurate with known adverse health effects. However, the long-term health effects of these emissions and their overall impact on the environment have not been well defined.

Coal also contains traces of uranium, thorium, and radium; consequently, during combustion, low levels of radionuclides would be emitted from coal-burning facilities. Studies of radioactive releases from 1000-megawatt power plants employing eastern coals have indicated that the observed levels of radioactive releases did not constitute a public health problem [46,47]. It is not known how radioactive releases from coal gasification or liquefaction plants would compare with those from fossil fuel power plants. Furthermore, a recent Environmental Protection Agency study has indicated that the lung dose from a 1000-megawatt power plant employing western coal could be significant (see U.S. Environmental Protection Agency comments in Appendix E of Reference 39).

Emission Control Standards. Production facilities using fossil-fuel steam generators must meet Environmental Protection Agency (EPA) new source performance standards (NSPS). The baseline regulation is summarized in Table 5-28. The Clean Air Act Amendments of 1977 require EPA to revise the current standards of performance for fossil fuel-fired stationary sources. The intended effect of recent EPA proposed standards is to require new, modified, and reconstructed electric utility steam generating units to use the best demonstrated systems of continuous emission reduction and to satisfy the requirements of the Clean Air Act Amendments of 1977.

The principal issue associated with the proposed standards is whether electric utility steam generating units firing low-sulfur coal should be required to achieve the same percentage reduction in potential sulfur dioxide emissions as those burning higher sulfur content coal. Resolving this question of full versus partial control is difficult because of the significant environmental, energy, and economic implications associated with each alternative. The Administrator of EPA has not made a decision on which of the alternatives should be adopted in the final standard.

The proposed standards would apply to electric utility steam generating units that are capable of firing more than 73 megawatts (250 million Btu/hour heat input of fossil fuel) and for which construction is commenced after September 18, 1978.

The proposed sulfur dioxide (SO₂) standards would limit emissions to 1.2 lb/million Btu heat input for solid fuel (except for 3 days per month) and 0.80 lb/million Btu for liquid and gaseous fuel (except for 3 days per month). Also, uncontrolled SO₂ emissions from solid, liquid, and gaseous fuel would be required to be reduced by 85 percent regardless of the sulfur content of the fuel burned. Credit would be given, however, for sulfur removed in fuel pretreatment or removed in bottom ash. The percent reduction requirement would not apply if

SO₂ emissions into the atmosphere would be less than 0.20 lb/million Btu heat input without pollution controls.

The proposed particulate matter emission standard would limit emissions to 0.03 lb/million Btu heat input. The proposed opacity standard would limit the opacity of emissions to 20 percent (6-minute average).

The proposed NO₂ emission standards vary according to fuel characteristics as follows:

- 0.50 lb/million Btu heat input from the combustion of subbituminous coal, shale oil, or any solid, liquid, or gaseous fuel derived from coal.
- 0.60 lb/million Btu heat input from the combustion of bituminous coal.

Several states within the coal regions have promulgated sulfur oxide and particulate emissions limitations for the combustion of coal that are stricter than the proposed Federal standards. The stricter standards are noted in Table 5-29.

Under the Clean Air Act of 1970, EPA was directed to establish National Ambient Air Quality Standards (NAAQS) to protect public health (primary standards) and public welfare (secondary standards). As of October 1978, EPA has established NAAQS for criteria pollutants—sulfur oxides, particulates, carbon monoxide, photochemical oxidants, nitrogen oxides, and hydrocarbons. The NAAQS and the recommended Federal episode criteria established by the EPA are given in Table 5-30.

By August 7, 1977, EPA was required to identify those portions of the country that were not meeting the primary or secondary NAAQS for particulates, sulfur oxides, nitrogen oxides, hydrocarbons, photochemical oxidants, or carbon monoxide. Areas for which sufficient data existed to permit their being identified as exceeding standards were designated as nonattainment areas for the pollutant(s) considered. Other areas were designated as attainment areas. Under the 1970 legislation, all states were to have attained the NAAQS by mid-1977. Under the 1977 amendments to the Clean Air Act, all NAAQS must be attained by 1983, with special provisions for extending the primary NAAQS attainment dates for photochemical oxidants and carbon monoxide until 1987 at the latest. Thus, according to plan, all areas of the country should be attainment areas by 1987. Table 5-31 shows the number of Air Quality Control Regions (AQCR) that lie wholly or partially in each coal region and the number that are designated as nonattainment areas.

Under the amendments to the Clean Air Act, unless a state implementation plan (SIP) is approved, EPA is empowered to prevent or halt the construction of any new emission source which would seek to locate either in a nonattainment area or in an area from which the source could potentially exacerbate a NAAQS violation in a nearby nonattainment area. At the present time, EPA is moving to establish a uniform litigation-oriented approach to enforcing the act. Violation of the standards, criteria, or guidance of an EPA approved SIP would be sufficient basis for Federal (civil and criminal) enforcement. Inadequate administration of a SIP would permit EPA to displace the state authority and assume enforcement responsibilities.

In attainment areas, a specific EPA program to prevent significant deterioration of ambient air quality is in effect. Under EPA's regulatory scheme for prevention of significant deterioration (PSD), areas of the Nation having attained both

TABLE 5-27

TRACE ELEMENTS AND EMISSIONS FROM FOSSIL FUELS

ELEMENT	COAL		OIL	
	CONCENTRATION (ppm)	EMISSION FACTOR (g/10 ⁶ Btu) (a)	CONCENTRATION (ppm)	EMISSION FACTOR (g/10 ⁶ Btu) (b)
Antimony	5.0	0.20	<0.024	0.0059
Arsenic	32.0	1.3	<0.08	0.002
Barium	500.0	20.2	<0.11	0.003
Beryllium	2.44	0.099		
Boron	61.0	2.47		
Cadmium	0.03	0.001		
Chlorine	160.0	6.48		
Chromium	15.4	0.624		
Cobalt	4.8	0.194		
Copper	13.5	0.547		
Fluorine	82.0	3.32		
Lead	9.5	0.38		
Manganese	50.0	2.02	<0.04	0.001
Mercury	0.15	0.0061		
Nickel	14.8	0.599	16	0.39
Selenium	2.2	0.089		
Tellurium	1.0	0.04		
Thallium	0.3	0.01		
Tin	0.9	0.036	<0.8	0.02
Titanium	385.0	15.6		
Vanadium	26.4	1.07	9.0	0.22
Zinc	12.0	0.49		

(a) Based on heating value of 11,200 Btu/lb for coal as burned.

(b) Based on heating value of 18,400 Btu/lb for residual oil as burned.

Source: Reference Number 45.

TABLE 5-28

SELECTED NEW SOURCE PERFORMANCE STANDARDS (NSPS)
FOR AIR POLLUTANT SOURCES

SOURCE	POLLUTANT	EMISSIONS NOT TO EXCEED
Fossil-Fuel Steam Generators ($>250 \times 10^6$ Btu/hr input)	Particulate Matter	0.10 lb/ 10^6 Btu input
	Opacity	20 percent Opacity except for one two-minute period per hour of not more than 40 percent Opacity
	Oxides of Sulfur (as SO ₂)	1.2 lb/ 10^6 Btu input (solid fuel)
		0.8 lbs/ 10^6 Btu input (liquid fuel)
	Nitrogen Oxides (as NO ₂)	0.70 lb/ 10^6 Btu input (solid fuel except lignite or fuel containing more than 25 percent by weight of coal refuse)
		0.20 lb/ 10^6 Btu input (gaseous fuel)
		0.30 lb/ 10^6 Btu input (liquid fuel)

Source: 40 CFR 60.40

TABLE 5-29

STATE NEW SOURCE PERFORMANCE STANDARDS

STATE	TSP (lbs/MM Btu)	SO _x (lbs/MM Btu)	NO _x (lbs/MM Btu)
Arizona	*	0.8 ^(a)	*
Colorado	*	5 tons/day ^(b)	*
New Mexico	0.051; 0.021 fine	0.34 ^(c)	0.45 ^(c)
Pennsylvania	*	0.6 ^(d)	*
Wyoming	*	0.2 ^(e)	*
Ohio	*	1.0 ^(f)	*

* Equal to or less stringent than Federal NSPS.

Sources:

- (a) Reference Number 78.
- (b) Reference Number 79.
- (c) Reference Number 80.
- (d) Reference Number 81.
- (e) Reference Number 82.
- (f) Reference Number 83.

TABLE 5-30

NATIONAL AMBIENT AIR QUALITY STANDARDS
AND RECOMMENDED FEDERAL EPISODE CRITERIA
(at 25°C and 760 mm pressure)

POLLUTANTS UNITS AVERAGING TIME(a)	SECONDARY (b)	PRIMARY (c)	ALERT (d)	WARNING (d)	EMERGENCY (d)	SIGNIFICANT HARM
<u>Sulfur dioxide</u>						
$\mu\text{g}/\text{m}^3$		80				
1 year		365	800	1,600	2,100	2,620
24 hours(e)	1,300					
3 hours(e)						
<u>Particulate Matter</u>						
$\mu\text{g}/\text{m}^3$		75				
1 year	60	260	375	625	875	1,000
24 hours(e)	150					
<u>Product of Sulfur dioxide and Particulate Matter</u>						
$[\mu\text{g}/\text{m}^3]^2$			6.5×10^4	2.61×10^5	3.93×10^5	
<u>Carbon monoxide</u>						
mg/m^3						
8 hours(e)	10	10	17	34	46	57.5
1 hour(e)	40	40				
<u>Oxidants</u>						
$\mu\text{g}/\text{m}^3$						
1 hour	160	160	400	800	1,000	1,200
<u>Nitrogen dioxide</u>						
$\mu\text{g}/\text{m}^3$						
1 year	100	100	282	565	750	
24 hours			1,130	2,260	3,000	3,750
1 hour						
<u>Hydrocarbons</u>						
$\mu\text{g}/\text{m}^3$						
3 hours(e) (6-9 a.m.)		160				

(a) $\mu\text{g}/\text{m}^3$ - micrograms of pollutant per cubic meter of air.

mg/m^3 - milligrams of pollutant per cubic meter of air.

$[\mu\text{g}/\text{m}^3]^2$ - product of the concentration of one pollutant measured in micrograms per cubic meter and the concentration of a second pollutant measured in micrograms per cubic meter.

(b) National secondary ambient air quality standards are, in the judgment of the EPA Administrator, requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air.

(c) National primary ambient air quality standards are, in the judgment of the EPA Administrator, requisite to protect the public health.

(d) The Federal Episode Criteria specify that meteorological conditions are such that pollutant concentrations can be expected to remain at these levels for 12 or more hours or increase; or, in the case of oxidants, the situation is likely to reoccur within the next 24 hours unless control actions are taken.

(e) Maximum concentration allowed once yearly.

Source: 40 CFR 50-99.

TABLE 5--31
STATUS OF ATTAINMENT FOR COAL REGION
AIR QUALITY CONTROL REGIONS (a)

REGION	PARTICULATES			SULFUR DIOXIDE			NITROGEN DIOXIDE			OXIDANTS		
	AREAS IN COMPLIANCE	AREAS WITH VIOLATIONS	AREAS WITH INADEQUATE DATA	AREAS IN COMPLIANCE	AREAS WITH VIOLATIONS	AREAS WITH INADEQUATE DATA	AREAS IN COMPLIANCE	AREAS WITH VIOLATIONS	AREAS WITH INADEQUATE DATA	AREAS IN COMPLIANCE	AREAS WITH VIOLATIONS	AREAS WITH INADEQUATE DATA
Northern Appalachian	1	11	--	6	4	2	--	1	11	--	5	7
Central Appalachian	1	8	--	7	2	--	4	--	5	1	1	7
Southern Appalachian	--	4	--	3	1	--	1	--	3	--	1	3
Eastern Interior	1	11	--	4	8	--	11	--	1	3	5	4
Western Interior	1	15	--	14	1	1	6	--	10	2	3	11
Texas	--	6	--	6	--	--	5	--	1	--	3	3
San Juan River	--	5	--	4	--	1	1	--	4	--	1	4
Uinta-Southwestern Utah	--	3	1	1	1	2	1	--	3	--	1	3
Green River-Hams Fork	--	3	--	2	--	1	--	--	3	--	--	3
Powder River	1	3	--	3	--	1	--	--	4	1	--	3
Fort Union	1	3	--	3	--	1	--	--	4	1	--	3
Denver-Raton Mesa	--	4	--	1	--	3	1	--	3	--	1	3
TOTAL	6	76	1	54	17	12	30	1	52	8	21	54

Total Regions = 83

(a) Source: Reference Number 84.

REGIONAL IMPACTS

primary and secondary NAAQS, which should include all areas of the country by 1987 at the latest, could be designated under any of three "classes." Specified numerical "increments" of particulate matter are permitted up to a level considered to be significant for areas designated within a particular class. The allowable PSD increments are presented in Table 5-32. By August 7, 1979, EPA must promulgate PSD regulations for hydrocarbons, photochemical oxidants, carbon monoxide, and nitrogen oxides which would become effective 1 year later. States must submit SIP revisions within 21 months of EPA's promulgation of the increments. All areas subject to PSD have been initially designated as Class II, with the exception of certain Federal lands which are mandatory Class I areas, such as national parks. The highly restrictive Class I numerical increments were designed to severely limit industry and to protect pristine areas. All sources must be analyzed not only for air quality impact in their immediate area, but also for their impact on neighboring areas. In order to prevent deterioration of air quality in areas in which the most restrictive PSD numerical increments are applicable, it is necessary to control emissions from sources both within the geographic boundaries of the most restrictive areas and from sources locating in less restrictive areas if the sources in less restrictive areas could cause significant air quality deterioration in neighboring more restrictive areas. For example, construction of a power plant in a Class III PSD area could be prohibited if an air quality analysis for the specific facility found that emissions were sufficient to violate the permitted increments of a Class II area several miles away. The allowable PSD increments are increases in pollutant levels over a baseline concentration as of January 6, 1975. The base concentrations represent a status quo point against which air quality is measured. Regardless of the allowable increments, the NAAQS represent ceilings above which ambient concentrations will not be allowed to rise. All sources planning to locate in a given area are required by EPA to demonstrate that their emissions, in conjunction with the effects of growth and emission reductions occurring since the end of 1974, would not violate the applicable NAAQS or the allowable PSD increments in that area.

Although approval or disapproval of a source permit would be based on the emissions directly related to the source, the indirect or secondary emissions resulting from growth associated with the action, such as community expansion, must also be considered in the PSD increments. Temporary emissions such as those associated with construction are specifically exempt from consideration even if they would contribute to air quality degradation in excess of an ambient air quality standard.

Program Alternatives Analyses. The following discussion addresses the aggregated air emissions associated with each region and each alternative. In order to put these estimates in perspective, Table 5-33 contains the most recent EPA estimates of criteria pollutant total emissions on a national basis.

Tables 5-34 through 5-38 present data comparing the emissions associated with the low, medium, and high production projections of the no new leasing alternative with current (1976) emissions. The data represent estimates of emissions from all sources associated with the coal cycle. The

three columns showing emissions at low, medium, and high production for 1976-1985 represent increases over the baseline 1976 values. The three columns showing emissions at low, medium, and high production for 1990-1985 represent increases or in a few cases decreases over 1985 estimates.

Although differences occur from region to region and from pollutant to pollutant, the following general and well established trends can be seen from the totals for all regions for every pollutant:

- The 1985 emissions for the low production level would be about 50 percent greater than the baseline.
- The 1990 increases for the low production level would only be from about one-third to one-half of the 1985 increases. While the 1985 emissions are estimated to be about 50 percent larger than in 1976, by 1990 they would increase only 10 to 20 percent over the 1985 levels.
- The total emissions associated with the medium production projection in 1985 would be only slightly smaller than the emissions for the high production projection in 1985. In both cases they represent about a 75 percent increase over the 1976 baseline.
- Relative to 1976 levels, total emissions by 1985 would increase by about 75 percent and by 1990 would double or triple under the high production projection.
- In general, this magnitude of increase could conceivably be large enough to prevent growth in the eastern or the western regions. In the industrialized East, the NAAQS could be exceeded and in the pristine West, the PSD requirements could be exceeded.
- On a percentage basis, the Texas Region would experience the greatest increase. A tenfold increase would occur by 1990 in that region for all pollutants except hydrocarbons where a fivefold increase would occur over 1976 levels. The Unita-Southwestern Utah Coal Region would experience the next highest increase.
- The Central Appalachian, Eastern Interior, Green River-Hams Fork, and Fort Union Coal Regions would experience the smallest increase, although, in general, a doubling would still occur.

Tables 5-39 through 5-43 show, for 1985 and 1990, the total emissions which would result under the no new leasing alternative together with the incremental change of the other alternatives measured against the no new leasing base case. Negative values indicate smaller amounts of emissions. With few exceptions, the incremental differences among alternatives are negligible, small fractions of one percent.

In the methodology employed to estimate emissions (i.e., the Coal Impact Estimation Program), power plant siting on a Btu basis did not change from alternative to alternative within a given year and within the high, medium, or low production projection. Therefore, any differences in emissions would come from interregional shifts in coal mining, beneficiation, and transportation. Emissions from these sources would be minor compared to those from coal conversion or steam electric power plants and the small differences between the numbers in the table are to be expected.

Only two differences in sulfur oxides emissions in 1985 and 1990 (Table 5-39) are significant; both occur in the

TABLE 5-32

PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS

APPLICABILITY	MAXIMUM ALLOWABLE DEGRADATION	
	SULFUR DIOXIDE	PARTICULATE MATTER
Class I Areas (Restricted Development)	2 $\mu\text{g}/\text{m}^3$ (annual arith. mean) 5 $\mu\text{g}/\text{m}^3$ (24-hour max.) 25 $\mu\text{g}/\text{m}^3$ (3-hour max.)	5 $\mu\text{g}/\text{m}^3$ (annual geo. mean) 10 $\mu\text{g}/\text{m}^3$ (24-hour max.)
Class II Areas (Modest Development)	20 $\mu\text{g}/\text{m}^3$ (annual arith. mean) 91 $\mu\text{g}/\text{m}^3$ (24-hour max.) 512 $\mu\text{g}/\text{m}^3$ (3-hour max.)	19 $\mu\text{g}/\text{m}^3$ (annual geo. mean) 37 $\mu\text{g}/\text{m}^3$ (24-hour max.)
Class III Areas (Concentrated Development)	40 $\mu\text{g}/\text{m}^3$ (annual arith. mean) 182 $\mu\text{g}/\text{m}^3$ (24-hour max.) 700 $\mu\text{g}/\text{m}^3$ (3-hour max.)	37 $\mu\text{g}/\text{m}^3$ (annual geo. mean) 75 $\mu\text{g}/\text{m}^3$ (24-hour max.) ^a

^aValue not to be exceeded more than once per year.

Source: 42 U.S.C. 7401.

TABLE 5-33

NATIONAL EMISSIONS ESTIMATES FOR 1975
(10³ tons/year)

SOURCE	PARTICU- LATES	SULFUR OXIDES	NITROGEN OXIDES	HYDRO- CARBONS	CARBON MONOXIDE
Fuel Combustion (Point and Area)	5,800	22,900	12,500	1,500	1,300
Industrial (Point)	7,700	4,800	700	9,300	7,900
Solid Waste Disposal (Point and Area)	500	50	200	900	3,100
Transportation (Area)	1,300	800	10,800	13,200	79,400
Miscellaneous (Area)	500	0	100	3,900	2,800
Total (Point and Area)	15,800	28,500	24,300	28,800	94,500

Source: Reference Number 85.

TABLE 5- 34

NO NEW LEASING ALTERNATIVE, SULFUR OXIDES AIR EMISSIONS
(Tons/yr)

REGIONS	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985-1976	1990-1985	1985-1976	1990-1985	1985-1976	1990-1985
Northern Appalachian	198,312	21,124	- 1,027	15,350	41,688	22,502	178,663
Central Appalachian	107,946	179	34,946	16,173	61,568	12,520	84,912
Southern Appalachian	46,272	35,626	13	63,800	12,802	62,650	44,134
Eastern Interior	250,325	91,512	34,921	107,150	33,847	127,079	60,659
Western Interior	159,545	190,098	27,589	286,568	268,259	301,098	302,401
Texas	15,531	57,004	19,191	92,979	88,666	94,284	96,728
Powder River	5,950	6,636	3,645	7,397	3,824	9,034	4,520
Green River-Hams Fork	7,113	4,869	1,892	6,957	483	7,298	1,442
Fort Union	7,874	4,150	4,028	4,247	11,324	11,055	7,183
San Juan River	6,803	210	1,510	525	800	4,548	8,258
Uinta-Southwestern Utah	3,554	13,207	4,731	13,289	2,872	14,870	6,900
Denver-Raton Mesa	5,498	5,106	2,520	7,036	5,465	8,233	7,060
TOTAL	814,723	429,721	133,959	621,471	531,598	679,721	802,815

TABLE 5- 35

NO NEW LEASING ALTERNATIVE, PARTICULATE AIR EMISSIONS
(Tons/yr)

REGIONS	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985-1976	1990-1985	1985-1976	1990-1985	1965-1976	1990-1985
Northern Appalachian	119,933	14,468	- 2,488	11,786	21,553	16,217	91,305
Central Appalachian	60,609	406	9,115	5,679	19,685	2,433	38,933
Southern Appalachian	33,677	23,249	- 408	43,830	7,872	44,957	29,142
Eastern Interior	99,797	45,885	22,097	50,374	29,874	50,856	47,829
Western Interior	45,025	50,821	7,384	76,546	72,471	80,724	85,787
Texas	14,655	58,988	19,071	92,631	89,622	91,782	104,799
Powder River	10,275	21,233	7,981	27,901	10,792	37,210	26,331
Green River-Hams Fork	7,448	4,842	4,312	10,313	1,935	13,161	2,724
Fort Union	9,083	3,434	5,246	2,939	15,185	15,098	9,447
San Juan River	7,432	925	4,419	2,460	6,374	8,176	14,716
Uinta-Southwestern Utah	3,646	9,664	5,308	11,778	5,125	14,942	7,964
Denver-Raton Mesa	4,084	6,022	5,379	8,596	8,009	10,527	6,153
TOTAL	415,664	239,937	87,416	344,833	288,497	386,083	387,264

TABLE 5- 36

NO NEW LEASING ALTERNATIVE, CARBON MONOXIDE AIR EMISSIONS
(Tons/yr)

REGIONS	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985-1976	1990-1985	1985-1976	1990-1985	1985-1976	1990-1985
Northern Appalachian	99,891	14,366	- 286	18,259	16,675	16,459	67,727
Central Appalachian	36,740	2,688	9,125	8,220	19,706	9,333	28,636
Southern Appalachian	33,676	21,320	1,071	35,962	11,534	37,075	28,763
Eastern Interior	68,314	25,156	7,519	29,416	12,658	33,598	21,515
Western Interior	46,971	36,208	6,960	53,904	51,082	58,893	65,585
Texas	16,921	41,654	13,552	66,525	62,932	67,888	72,993
Powder River	10,670	11,016	4,837	13,687	6,748	17,017	9,460
Green River-Hams Fork	9,773	5,986	2,627	2,022	2,304	10,309	4,555
Fort Union	14,047	6,430	5,468	6,817	17,332	17,063	12,771
San Juan River	5,209	500	1,273	1,023	1,462	4,011	6,764
Uinta-Southwestern Utah	4,067	6,382	2,660	7,374	3,061	9,241	4,706
Denver-Raton Mesa	12,377	10,314	4,787	14,114	11,462	16,739	12,529
TOTAL	358,656	182,020	59,593	257,323	216,956	297,626	310,462

TABLE 5-37

NO NEW LEASING ALTERNATIVE, NITROGEN OXIDES AIR EMISSIONS
(Tons/yr)

REGIONS	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985-1976	1990-1985	1985-1976	1990-1985	1985-1976	1990-1985
Northern Appalachian	557,342	63,464	- 1,080	48,673	126,677	73,066	497,565
Central Appalachian	251,794	7,414	76,981	45,265	142,809	49,938	199,388
Southern Appalachian	205,431	156,558	970	280,109	59,649	276,037	197,290
Eastern Interior	444,357	162,571	58,207	191,927	66,742	226,529	119,259
Western Interior	246,164	245,588	40,246	367,907	346,502	392,599	410,192
Texas	93,705	338,468	112,956	550,885	526,988	558,723	585,698
Powder River	48,181	59,925	33,633	65,910	10,033	77,402	33,364
Green River-Hams Fork	53,523	37,117	14,902	53,613	- 4,664	56,291	8,681
Fort Union	74,919	31,313	40,661	20,018	120,199	103,707	54,842
San Juan River	40,642	1,427	9,175	3,536	1,979	27,662	49,886
Uinta-Southwestern Utah	16,872	63,976	22,566	64,074	13,588	71,040	33,695
Denver-Raton Mesa	45,967	60,988	34,364	83,585	59,562	96,816	52,120
TOTAL	2,078,879	1,228,839	443,581	1,775,502	1,470,064	1,617,211	2,241,980

TABLE 5-38

NO NEW LEASING ALTERNATIVE, HYDROCARBON AIR EMISSIONS
(Tons/yr)

REGIONS	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985-1976	1990-1985	1985-1976	1990-1985	1985-1976	1990-1985
Northern Appalachian	122,251	18,442	-2,072	32,376	5,116	16,654	42,579
Central Appalachian	16,085	930	3,276	3,361	8,225	4,119	12,996
Southern Appalachian	26,661	11,504	1,432	15,222	9,314	17,882	15,856
Eastern Interior	52,913	22,655	5,440	23,982	11,517	26,796	19,957
Western Interior	26,244	16,040	4,416	24,288	24,947	26,771	36,851
Texas	9,359	15,769	5,463	24,732	20,427	25,361	27,650
Powder River	5,852	4,326	1,757	5,556	12,748	8,272	6,079
Green River-Hams Fork	4,983	2,919	1,052	3,969	5,856	4,522	3,361
Fort Union	7,461	6,282	3,482	9,716	7,913	11,508	10,322
San Juan River	1,809	206	392	453	4,049	1,348	2,195
Uinta-Southwestern Utah	5,405	- 1,505	860	1,044	3,938	4,468	1,783
Denver-Raton Mesa	9,862	6,232	2,159	7,921	7,795	10,070	11,834
TOTAL	288,885	103,860	27,657	152,620	121,845	157,771	191,463

TABLE 5-39
SULFUR OXIDE EMISSIONS
(tons)

COAL REGION	Program Alternatives										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA'S ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	219423	213649	220801	-26.3	-13.4	-223	-8028	-8015	-7765	13.0	-7962
Central Appalachian	168112	124106	125453	-254	-846	-1551	-622	-694	-506	-406	-720
Southern Appalachian	81885	110059	108909	-26.3	-1982	675	-1355	-1628	-1634	-3449	-1600
Eastern Interior	341824	357462	377391	-26.4	-734	2275	-985	-999	1624	-10560	-2392
Western Interior	349603	446072	460602	-82.4	-17226	31933	-23380	-21465	-5536	12984	-22592
Texas	72524	108499	109804	52.1	416	-4331	-862	-459	-1191	-396	2231
Powder River	12576	13337	14974	-19.4	-9.09	330	-18.7	-4.3	454	-133	-172
Green River-Hams Fork	11974	14062	14404	-14.4	289	390	-97.2	22.0	856	570	71.3
Fort Union	12013	12110	18918	799	862	256	860	872	1559	172	1410
San Juan River	7012	7327	11350	-2.0	-1	10.6	-39.5	-38.5	-6.26	-917	-16.1
Uinta-Southwestern Utah	16759	16841	18421	-3.6	446	341	51.4	187	653	448	453
Denver-Raton Mesa	10590	12520	13717	-28.4	255	276	235	249	794	1088	7.43
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	218588	255337	399464	3931	350	9524	-2.3	-46.3	228	268	-139
Central Appalachian	143242	185674	210365	19	91.3	8972	3279	58.8	1707	41.2	-4826
Southern Appalachian	82088	122861	153043	19.7	97.5	10789	1109	55.7	778	250	-1582
Eastern Interior	376037	391309	438050	4980	86.5	19132	612	-2033	1030	1477	-4424
Western Interior	377788	714331	762603	859	294	43097	-15591	-15912	20500	16500	-39259
Texas	91879	197164	209532	-207	35.4	2006	-3082	-2621	-2587	-801	-2644
Powder River	16362	17161	19494	62	358	2706	75.8	-184	734	467	-541
Green River-Hams Fork	13970	14545	15846	77.2	172	2263	-748	-840	591	350	-995
Fort Union	16209	23435	26101	17.4	59.5	503	238	346	1251	-1598	420
San Juan River	8536	8127	19608	154	59.3	151	-7.21	-87.2	27.4	-91.5	-175
Uinta-Southwestern Utah	21516	19713	25321	573	106	1591	-997	-890	313	124	-718
Denver-Raton Mesa	13316	17985	20777	21.3	106	2658	-213	-201	462	554	-734

TABLE 5-40

TOTAL SUSPENDED PARTICULATES EMISSIONS

(tons)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	134395	131713	136144	0.5	-16.4	-216	-3829	-3835	-3890	-18.1	-3888
Central Appalachian	61009	66282	136144	-11.1	-387	-809	-182	-291	-1712	-357	459
Southern Appalachian	56921	77501	78629	-11.5	-1475	143	-1058	-1107	-625	-3092	-1723
Eastern Interior	145676	150165	150647	-11.6	237	-986	-350	-198	-1113	-3873	201
Western Interior	95828	121554	125731	-52.4	-4581	8382	-6173	-5608	-1949	3014	-5696
Texas	73638	107280	106432	72.9	673	-5783	-848	-367	-2910	-1151	3851
Powder River	31503	38171	31495	-8.5	216	3333	11.2	86.1	2995	-39.0	-2428
Green River-Hams Fork	12287	17758	20606	-6.3	679	3707	173	135	4647	4480	-2018
Fort Union	12511	12017	24176	1174	1283	235	1286	1291	2527	-662	2532
San Juan River	8356	9891	15607	-0.9	26.3	44.6	-36.7	-36.2	655	-1220	910
Uinta-Southwestern Utah	13368	15422	18587	-1.59	352	288	87.9	139	1216	-176	276
Denver-Raton Mesa	10100	12674	14605	-12.4	435	281	409	416	1120	1914	213
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	131991	153266	227449	869	219	3349	-41.6	-30.4	-155	429	694
Central Appalachian	70205	85967	97211	-3.7	-557	97.6	918	-131	-483	-627	219
Southern Appalachian	56596	85373	107766	8.6	-94.2	6965	752	45.7	1018	-1562	-2707
Eastern Interior	167857	180039	198476	1.5	-1585	-3162	-2539	-1156	-6425	-1370	5832
Western Interior	103473	194025	211518	188	-790	6526	-4721	-4301	3895	2761	-9446
Texas	92781	196903	211231	-325	-4063	-4923	-3272	-2896	-9897	-5715	-3471
Powder River	39546	48963	57826	111	11817	34476	5772	1223	17959	11404	-4153
Green River-Hams Fork	16644	19693	23330	472	2541	7544	-174	108	6171	5967	-4631
Fort Union	17831	27832	33623	7.6	-830	-1129	104	614	1671	-5166	1179
San Juan River	12782	16264	30323	315	-964	34.7	-362	-144	324	-2346	570
Uinta-Southwestern Utah	18628	20548	26551	556	-591	429	-1175	-601	635	-3522	-1135
Denver-Raton Mesa	15570	20683	20758	180	181	1274	-122	-216	278	-1439	-898

TABLE 5-41

CARBON MONOXIDE EMISSIONS

(tons)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	114222	118116	116315	-68.1	-35.7	114	-5133	-5100	-4452	32.7	-4966
Central Appalachian	39399	44930	46043	-60.6	-242	-124	-190	-187	267	-91.6	-30.9
Southern Appalachian	54966	69607	70721	-60.9	-1124	589	-790	-900	-401	-1759	-860
Eastern Interior	93438	97697	101880	-64.4	-126	647	-250	-205	797	-1894	-325
Western Interior	83084	100780	105770	-189	-2258	4896	-3073	-2734	817	1668	-2486
Texas	58547	83418	84781	-459	298	-2815	-595	-295	-595	-317	1769
Powder River	21663	24334	27664	-45.0	-17.8	963	-34.0	-6.54	1116	-132	-567
Green River-Hams Fork	15743	18884	20065	-32.8	320	1072	-67.3	33.5	1682	1255	-295
Fort Union	20450	20837	31084	1011	112.3	440	1115	1142	2365	41.9	2003
San Juan River	5706	6229	9217	-50.6	-0.109	29.5	-28.8	-26.3	137	-649	146
Uinta-Southwestern Utah	10445	11436	13303	-9.10	254	259	27.7	106	458	249	268
Denver-Raton Mesa	22658	26459	29084	-64.7	479	580	437	470	1632	2044	57.6
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	114438	134791	184042	2730	3620	5218	-30.8	-121.0	565	715	-319
Central Appalachian	48963	64637	74679	44.7	190	3100	755	-89.6	833	513	-1330
Southern Appalachian	56478	81141	99482	45.7	219	6251	586	-50.9	847	494	-1214
Eastern Interior	101423	110355	123395	140	135	38296	26.6	-600	289	627	-871
Western Interior	91409	151867	171357	235	585	8558	-2132	-2333	3848	3626	-5739
Texas	72506	146350	157774	-121	-272	1469	-2099	-1855	-2193	-659	-2065
Powder River	26826	31081	37124	83.7	2401	8617	1134	48.3	3894	2591	-1352
Green River-Hams Fork	18608	21189	24620	149	657	3230	-593	-622	1723	1555	-1697
Fort Union	26308	38168	43855	40.3	-12.2	826	274	466	1826	-2422	586
San Juan River	7016	7691	15981	104	-139	130	-98.6	-84	61.2	65.6	-56.4
Uinta-Southwestern Utah	13170	14496	18009	308	71	1081	-614	-553	266	89.6	-496
Denver-Raton Mesa	27915	37921	41613	48.5	243	12713	-411	-400	989	1162	-1445

TABLE 5-42

NITROGEN OXIDE EMISSIONS
(tons)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	620720	605929	630322	-170	-87.9	-84.6	-21272	-21187	-19568	82.9	-20851
Central Appalachian	259125	296976	301650	-170	-1892	-2824	-1422	-1529	-231	-848	-1289
Southern Appalachian	361904	485455	481383	-171	-8476	3128	-5826	-6947	-6356	-14865	-6766
Eastern Interior	606862	636198	670800	-172	-1212	4320	-1757	-1687	3818	-17856	-3703
Western Interior	491489	613803	638495	-536	-19672	38232	-26719	-24323	-2378	14733	-24654
Texas	432099	644517	652354	295	2454	-25764	-5135	-2734	-7084	-2433	13338
Powder River	108043	114028	125519	-126	-55.3	2893	-132	-23.8	3968	-1295	-1942
Green River-Hams Fork	90594	107089	109768	-93.4	2345	3427	-729	192	7098	5021	249
Fort Union	106157	94862	178551	9394	10275	2260	10282	10357	17334	1940	16495
San Juan River	40026	44171	68297	-13.1	-2.6	72.5	-235	-228	84.5	-5478	62.8
Uinta-Southwestern Utah	80836	50934	87900	-23.5	2097	1622	241	878	3155	2098	2140
Denver-Raton Mesa	106863	129460	142691	-184	4031	2963	3775	3867	9832	16675	-335
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	620886	732606	1127887	10369	1337	27843	-58.2	-301	1432	1759	-837
Central Appalachian	337303	439785	501038	123.0	559	20311	6998	-78.9	4549	1134	-10798
Southern Appalachian	364113	545104	678673	128	625	47587	4685	133	3840	1521	-7162
Eastern Interior	666315	702940	790061	924	469	34216	853	-3702	2252	3292	-7556
Western Interior	535606	960305	1048687	1292	1805	57142	-17961	-18778	26499	22710	-46422
Texas	546127	1171504	1243052	-1222	-162	11467	-18265	-15564	-15933	-5096	-15812
Powder River	142589	124060	158883	545	4130	25219	1896	-737	7544	4768	-4291
Green River-Hams Fork	106173	102426	118449	641	1590	15022	-5333	-5913	4975	3309	-7694
Fort Union	147909	215060	234693	113	214	2397	3368	4996	13450	-20186	6562
San Juan River	51332	46151	118183	910	156	868	-178	-537	160	520	-896
Uinta-Southwestern Utah	103573	94522	121597	2720	513	7578	-4665	-4170	1537	597	-3417
Denver-Raton Mesa	142563	189022	194811	138	691	8535	-3139	-2631	4993	5972	-9990

TABLE 5-43
HYDROCARBON EMISSIONS
(tons)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	138671	152606	136883	-43.5	-22.0	-219	-9789	-9767	-9354	21.5	-9681
Central Appalachian	16994	19426	20183	-41.9	-86.4	88.9	-77.6	-64.0	315	-14.1	21.3
Southern Appalachian	38144	41862	44521	-43.4	-80.6	469	-557	-631	-275	-704	-609
Eastern Interior	75547	76874	79687	-43.6	-102	437	-156	-132	533	-249	-225
Western Interior	42216	50464	52947	-136	-703	1864	-972	-831	1022	655	-612
Texas	25109	34072	34702	-18.4	141	-675	-159	-51.4	6.65	-33.1	687
Powder River	10162	11393	14109	-32	-151	401	-24.6	-7.10	454	-29.9	-84
Green River-Hams Fork	7891	8941	9494	-23.7	79.7	314	-34.6	4.22	542	292	-16.2
Fort Union	13724	17157	18949	340	326	291	318	337	901	49.2	626
San Juan River	2073	2260	3156	-33.3	-1.22	17.4	-10.0	-8.33	44.2	-188	27.8
Uinta-Southwestern Utah	3836	6446	9870	-5.97	137	222	13.0	57.2	252	140	149
Denver-Raton Mesa	16070	17759	19909	-46.8	290	400	265	288	1055	1057	37.7
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	136916	157722	179462	5476.3	272	5328	-14.4	-76.4	366	440	-220
Central Appalachian	20574	27652	33179	31.3	152	1639	225	-66.8	454	398.0	-547.0
Southern Appalachian	39890	51176	60377	32.5	161.0	2707	433.0	-33.9	588.0	417.0	-816.0
Eastern Interior	81307	88391	99654	86.8	144.0	114458	52.9	-487	256	698	-804
Western Interior	47616	75412	89798	131	487	4663	-717	-900	1904	1949	-22770
Texas	30844	54499	62352	-30.1	74.1	1017	-687	-631	-420	64.2	-730
Powder River	12152	24140	20188	39	547	3093	-70.7	-383	1119	730	-790
Green River-Hams Fork	9115	14796	12855	46.9	197	1176	-498	-566	658	477	-827
Fort Union	17483	25070	29271	28.6	102.0	1024	-73.5	-109.0	836	-451	240
San Juan River	2489	6309	5351	32.5	-10.4	83.7	20.3	-28.6	56.8	41.9	-99.9
Uinta-Southwestern Utah	4739	10384	11653	94.7	34.8	725	-451	-408	179	64.8	-348
Denver-Raton Mesa	18569	25555	31743	35.1	175	37135	-257	-253	652	782	-922

REGIONAL IMPACTS

Western Interior Coal Region where about a 6 percent increase is forecast under the high case for the preferred program alternative and about a 5 percent decrease is forecast for the state determination of leasing levels alternative.

Particulates in 1985 and 1990 (Table 5-40) would generally decrease in the eastern regions for each alternative when compared with the no new leasing base case. For the western regions these values would generally increase. In both cases, however, the changes would rarely be greater than 10 percent and never more than 15 percent above the no new leasing alternative.

The 1985 and 1990 values for carbon monoxide emissions (Table 5-41) show a general decrease for the eastern regions and a general increase for the western regions.

Increases in nitrous oxides in 1985 and 1990 (Table 5-42), would be generally less in the eastern regions for the alternatives than for the no new leasing alternative although these other values are still usually only a few percentage points below the no new leasing base case. For the western regions in 1985, no change larger than about 2 percent is projected.

For hydrocarbons (Table 5-43) in 1985 only two alternatives would lead to an increase of as much as one percent over the no new leasing base case; both increases would occur in the Denver-Raton Mesa Coal Region. Similar results would be obtained in 1990.

5.2.3 Ecological Impacts

Ecosystems in each coal region would experience a number of impacts because of the increased coal development activity that is related to the various alternatives for a Federal coal management program. These impacts would include primarily disturbance and destruction of vegetation and wildlife populations and introduction of hazards to biota.

Secondary impacts resulting from induced growth, community change, and ecosystem adjustment would also occur. Disturbances and modifications of habitats adjacent to the areas of principal impacts would vary in degree primarily as a function of distance. This "area of influence" could encompass as much as five times the area directly disturbed, depending on species affected and type of impact [48].

Since the specific tracts which might be leased are presently unknown, it is not possible to indicate exact habitats which would be lost. Existing legislation and/or the lands unsuitability for use criteria (see section 5.4), however, protect sensitive habitats, such as endangered species critical habitat, alluvial valley floor habitat, wetlands, National Wildlife Refuges, National Wilderness Areas, Federally-designated wilderness study areas, high priority migrating bird habitat, raptor nests and roosts, and resident high interest wildlife habitat.

Off-road vehicles (ORVs) would be frequently used during the exploration phase of coal development as well as for recreation. The immediate impact of ORV travel would be to the surface where low growing vegetation might be injured and destroyed. Repeated travel over the same route could result in soil compaction, decreased water infiltration, and interference with root growth [49]. Increased runoff resulting from a reduced capacity of the compacted soils to absorb rainfall could lead to erosion, rut formation, and increased sediment loadings in adjacent waterways. Concentrated ORV

travel and frequent disturbances (noise and man's presence) in a given area might affect wintering big game, upset breeding behavior of animals and birds, and result in direct loss of some wildlife.

Since these disturbances are localized, the severity of impacts on the ecosystems would not vary appreciably under the program alternatives. Frequency of disturbance, however, would be dependent in part on the rate of growth in coal related activities and whether the activities would be concentrated or dispersed.

Vegetation removed during site preparation would result in loss of natural site productivity for wildlife. Indirect or secondary impacts would include an increase in the potential for site erosion, sedimentation, and introduction of pollutants into adjacent waterways, as well as disturbance of adjacent vegetation, habitat, and wildlife. Animal life would be adversely affected by losses of food, cover, and habitat. The initial impact would be greatest to soil micro- and macro-organisms, arthropods, small burrowing mammals, ground nesting birds, and slowly moving forms such as amphibians and reptiles. However, due to their relatively rapid population turnovers and high reproductive rates, these same groups of animals would likely be the first to repopulate reclaimed areas. Insects and other arthropods would begin to repopulate disturbed areas during and after revegetation. Diversity of species, however, could be lower than before development.

While direct mortality of larger, more mobile wildlife species would be rare, loss or disturbance of habitat would cause increased competition for food, cover, nesting sites, and territory, thereby potentially reducing wildlife populations over time. Comparatively speaking, fewer numbers of predators and large game mammals would be affected by habitat loss as both generally have larger territory requirements. The losses which might occur, however, would tend to be long term due to slower population turnovers and lower reproductive rates.

Wildlife dependent upon specific seasonal habitats would be affected by activities which removed or reduced these habitats. If development were to reduce habitats presently limiting the size of a particular wildlife population, that population would also be reduced in other habitat areas. Further secondary impacts could then be felt by predators, prey, or other links in the food chain of that species. Lands undergoing to coal development would decrease the total area available for wildlife and, initially, create increased crowding of adjacent habitats.

Ecosystems beyond the immediate development area could be temporarily or permanently disturbed by noise, air, and water emissions from community expansion, increased human presence and activity, and plant and mine operations. Most species tolerate human intrusions only to a certain point. Others, such as pronghorn antelope, are very wary of human presence [50]. The extent of these impacts would be dependent on the tolerance of a given species.

Coal development would result in the introduction of additional hazards into the environment. Fences constructed along rights-of-way, or around areas under construction and areas under rehabilitation, would reduce some populations such as deer and antelope [51]. Increased vehicular traffic would result in higher numbers of roadkills of various species. The presence of mining operations and support facilities could

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change migration patterns and grazing movements through changes in the quantity and quality of forage and water, as well as physically restricting movements by erecting impassable barriers, such as tall fences, deep ditches, and heavily travelled roadways.

Factors which limit distribution of aquatic organisms include temperature, turbidity, pH, water velocity, oxygen supply, conductivity, and substratum. Any one of these factors could be changed in adjacent streams and downstream rivers by effluents, accidental spills, impoundments, and/or erosion. Sufficient amounts of leached substances and saline groundwater released to surface waters from excavations or overburden piles could cause a shift in pH and conductivity into a range that would interfere with the vital functions of aquatic organisms. Acid drainage is a potential problem particularly in the eastern coal regions, while salinity poses more of a problem in the western coal regions.

Sediment introduced into surface waters by runoff could affect aquatic life in many ways; it could clog fish gills, bury eggs of both fish and insects, bury food sources, smother aquatic vegetation, and alter habitat. In addition, there are many indirect ways in which sediment could disrupt an aquatic system. For example, turbidity would decrease light penetration, thereby decreasing photosynthetic activity of aquatic plants and phytoplankton. This effect, in turn, could result in a reduction of dissolved oxygen concentration.

Development activities near surface water systems might also affect aquatic life through the introduction of various materials into the water body by overland runoff. Runoff frequently contains inorganic and organic matter originating from decayed vegetation and from the soil itself. Overland runoff could also leach minerals from exposed soils or might carry residues (oils, grease, pesticides, etc.) which are used during the construction period or which are present in the soil. The exact quantities of various pollutants which would enter a given water body would depend, to some extent, on the care taken to minimize their entry.

Any change in the physical characteristics of the stream substratum could result in extensive alteration in benthic composition (stream bottom communities). Species dependent on running water for food supply and on hard attachment surfaces for position maintenance could be replaced by organisms which typically live in the substratum rather than on it.

Alteration of benthic composition would affect species dependent upon these organisms as a food source. Species diversity of macroinvertebrates and fish in an impounded pool is usually substantially lower than in the pool's former unimpounded, free-flowing status [52]. Game fish would be replaced by more tolerant species, such as carp.

Large volumes of water would be required in all of the regions for mining and reclamation activities, coal conversion and use plants, conjunctive developments, and population increases (see section 5.2.2.6). Water withdrawals could affect aquatic systems by reducing habitats and by changing the physical regimes (principally dissolved oxygen and temperature) of the remaining water.

5.2.3.1 Productivity Loss. Table 5-44 presents potential losses of natural primary productivity (biomass) for the no new leasing alternative at low, medium, and high production

projections, and comparisons between the no new leasing and the other program alternatives. These potentials are based on the product of unweighted productivity averages (excluding agriculture) for each region and the surface area disturbed in each region. Potential losses weighted by major natural vegetation types are given in Appendix D, Tables D-5 through D-26. While actual productivity losses may vary, until specific sites are determined this comparison indicates differences between alternatives and between regions.

Potential productivity losses are based on *total* commitment of land disturbed for the period from 1976 to 1985 or 1986 to 1990. Since the Surface Mining Control and Reclamation Act of 1977 requires reclamation of surface mined lands, all productivity would not be lost for the entire period. Actual productivity losses and wildlife benefits derived from reclamation would depend on plant species used, intent and planned use of the reclaimed area, and success of the reclamation effort. The analysis presented here is thus conservative in its estimates.

Comparison between the no new leasing and the preferred alternatives at the medium coal production projection for the time period from 1976 to 1985 shows that coal related development would remove less natural productivity in the Appalachian and Western Interior Coal Regions and would remove up to 8 percent more in the Eastern Interior, Texas, and all western coal regions. Over the period 1986 to 1990, medium level coal production under the preferred program would result in a lower loss in primary production in comparison to the no new leasing alternative in all regions except the Northern Appalachian, Powder River, Green River-Hams Fork, and Denver-Raton Mesa Coal Regions. The largest increase would be a 23 percent higher loss in the Powder River Coal Region; the Fort Union Coal Region would lose about 17 percent more primary production of biomass.

Comparison of the lease PRLAs only and the no new leasing alternatives at the medium production levels in the 1978 to 1985 period indicates that lower primary productivity would occur in the West except in the Powder River and San Juan River Coal Regions; losses in the East would be consistently lower. Over the 1986 to 1990 time period, all regions except the Central and Southern Appalachian and Powder River Coal Regions would experience lower losses in productivity than under the no new leasing alternative; the loss in the Powder River Coal Region would be about 12 percent higher.

Comparison between the short-term leasing and no new leasing alternatives at medium production levels for 1976 to 1985 shows that moderate increases in productivity lost would result in the western coal regions. Over the 1986 to 1990 period, losses in productivity would be lower or would increase only slightly above those which would result under the no new leasing alternative.

Leasing to meet industry needs would generally remove slightly less natural productivity (on a percentage basis) in the East and considerably more in the West during both time periods. The lease to meet DOE production goals alternative would also cause considerably higher losses in some of the western regions.

Under the state determination of leasing levels alternative at the medium coal production projection, a general

TABLE 5-44

COMPARISON OF POTENTIAL PRIMARY PRODUCTIVITY LOSS
(thousand tons)

REGION	NO NEW LEASING			PREFERRED PROGRAM			PRLA'S ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
PERCENT CHANGE FROM NO NEW LEASING VALUE											
Northern Appalachian	2,500	2,460	2,540	0.0	-1.9	-0.2	-2.8	-2.8	-3.0	0.0	-2.9
Central Appalachian	1,400	1,500	1,400	0.0	-0.7	-1.6	-0.3	-0.5	-3.9	-0.8	1.2
Southern Appalachian	1,060	1,450	1,520	0.0	-2.0	-0.3	-1.5	-1.4	0.0	-5.2	-3.2
Eastern Interior	2,480	2,500	2,450	0.0	-0.5	-1.0	-0.2	0.0	-0.8	-2.4	0.4
Western Interior	1,140	1,410	1,450	0.0	-4.1	6.6	-5.3	-4.6	-6.0	0.0	14.7
Texas	890	1,230	1,180	0.1	1.1	-8.2	-0.7	-0.2	-5.7	-2.4	6.5
Powder River	375	465	600	0.0	0.2	7.4	0.0	0.1	8.1	-0.4	-7.8
Green River-Hams Fork	190	310	385	0.0	4.4	23.8	1.3	1.0	36.1	35.6	-17.7
Fort Union	180	215	380	8.5	7.5	0.7	-7.5	7.5	17.9	-11.4	18.8
San Juan River	95	130	200	0.0	0.3	0.3	-0.2	-0.2	13.2	-11.4	18.6
Uinta-Southwestern Utah	110	120	135	0.0	2.7	1.9	0.7	1.0	6.6	+0.5	2.0
Denver-Raton Mesa	135	180	220	0.0	4.3	1.8	4.1	4.1	15.3	24.1	6.3
PERCENT CHANGE FROM NO NEW LEASING VALUE											
Northern Appalachian	1,160	1,335	1,938	1.5	0.1	1.4	0.0	0.0	-0.2	-0.4	0.6
Central Appalachian	735	885	1,004	0.0	-1.0	-0.7	1.0	0.1	-0.4	-1.2	1.2
Southern Appalachian	510	775	993	0.0	-0.3	5.8	0.9	0.1	1.6	-3.4	-4.7
Eastern Interior	1,250	1,350	1,499	0.0	-1.2	0.0	1.0	-0.8	-4.4	-3.0	3.9
Western Interior	575	1,120	1,328	0.0	-2.6	-7.5	-3.8	-2.4	-1.7	-2.8	-3.1
Texas	560	1,135	1,266	-0.6	-5.4	-8.2	-1.8	-1.7	-12.1	-7.6	-2.6
Powder River	230	345	364	0.2	23.1	64.5	11.6	2.1	35.6	22.2	-9.3
Green River-Hams Fork	140	185	213	3.6	16.7	42.2	-0.6	1.9	41.6	40.4	-31.6
Fort Union	130	220	288	0.0	-5.8	-5.9	-1.3	1.3	5.1	-25.6	4.2
San Juan River	70	130	195	1.1	-11.2	-1.5	-5.2	-1.4	1.1	-3.9	4.2
Uinta-Southwestern Utah	70	70	94	2.8	-1.5	3.2	-5.3	-3.7	3.2	-9.0	-5.7
Denver-Raton Mesa	105	140	162	0.3	0.2	9.2	-1.8	-1.5	6.2	0.4	-5.5

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amelioration of the western impacts would occur when compared to the lease to industry needs or lease to meet DOE production goals alternatives. In the near term, this alternative, however, would create higher losses in the Fort Union and Green River-Hams Fork Coal Regions than those which would occur under the no new leasing alternative. Over the long term, no significant differences would be noticed.

5.2.3.2 *Habitat Losses.*

Habitat losses are dependent on the amount of land disturbed during program-related coal development activities. The degree of surface mining in a given region would be the major factor contributing to habitat loss. Right-of-way and generating plant construction would also cause habitat destruction, but to a much lesser degree. Appendix D (Tables D-5 through D-26) provides estimates per alternative of acreage disturbances which could result in the 12 coal regions.

Since the specific tracts which may be leased are presently unknown, it is not possible to indicate the exact habitat which would be lost. Existing legislation and/or the lands unsuitability criteria (see Section 5.4), however, protect sensitive habitats, such as endangered species critical habitat, alluvial valley floor habitat, wetlands, National Wildlife Refuges, units of the National Wilderness Preservation System, federally designated wilderness study areas, high priority migrating bird habitat, raptor nests and roosts, and resident high interest wildlife habitat. Accordingly, any habitat losses should be confined to nonsensitive ecosystems common to a given region.

Surface mining disturbances typically clear a land tract of vegetation and remove the area of overburden. The time involved varies among mine sites, although the land is generally committed to mining activity for 40 years. The vegetative disturbance is temporary in nature, as reclamation and natural succession commence immediately following surface mining. The type of vegetative losses would primarily be forestland, grassland (rangeland), or cropland. Appendix D (Tables D-5 to D-26) provides estimates of the anticipated productivity losses for these plant types.

The removal of vegetation with soils causes a concomitant loss of food, cover, and breeding sites for resident wildlife populations, as well as livestock herds. This would ultimately result in net reductions of these populations in the affected coal regions. Cattle and sheep herds would be removed from western grazing lands or eastern pasturelands, where surface mining occurs. Populations of burrowing mammals, ground nesting birds, reptiles, and soil organisms would be reduced by the elimination of both individuals and habitat due to coal-related excavation. More mobile wildlife, such as deer, songbirds, and predators, would flee to the surrounding areas, where they would create additional interspecific competition for food, cover, and nesting sites. Where interspecific competition is at the maximum level, a wildlife population is at its carrying capacity. If wildlife populations in the surrounding areas are already at their carrying capacities, which is generally the case with a stabilized ecosystem, the habitat will not be able to sustain any long-term population increases. Thus, the wildlife populations for mobile species would be also subject to losses on lands which already support populations at the carrying capacity. Table 5-45 presents estimates of potential big game

population reductions which would occur due to habitat loss as a result of the no new Federal leasing alternative at low, medium and high production projections. Table 5-45 also presents a comparison of potential big game population reductions of the no new Federal leasing versus other program management alternatives, carrying capacity information for typical types of wildlife. In addition, Appendix D provides estimates of potential wildlife losses by region per alternative that would occur as a result of habitat losses.

5.2.3.3 *Endangered Species.* Endangered and threatened species and their habitat are protected under the Endangered Species Act of 1973 for their aesthetic, ecological, historical, recreational, and scientific value. Regardless of which coal management alternative is adopted, any site selected for mining would require specific analysis to determine the presence of protected species or their habitat. If it is determined that such species or habitat does occur, the surface area may be designated as unsuitable for coal mining under lands unsuitability criteria (see Table 3-1 and discussion in Section 5.4.8).

Table 5-46 provides a summary list of endangered species found within the coal regions together with the developments that most severely threaten their continued existence. Included in this listing are animal species formally on the Federal endangered species list as of July 1977, and plant species as listed by the U.S. Fish and Wildlife Service news release of May 1978. Of the thirteen plant species which have been formally accepted as endangered or threatened, only three (Texas wild rice, northern wild monkshood, and Rydberg milk vetch) have been reported to occur in the coal regions. Proposed listings of plants such as the Smithsonian listing of 1975 are not included. The "Distribution" column lists general drainages or states where the species occur. In cases where the species occurs in several regions, these species are discussed once in the region most commonly inhabited. The major types of developments, which adversely impact these species, are listed in the "Most Serious Threat" column, conjunctive developments are mainly listed. However, as all new construction and mining would affect habitats, these also must be considered in planning for coal related development.

Guidelines for section 7 of the Endangered Species Act of 1973 were issued to all Federal agencies by the U.S. Fish and Wildlife Service on April 22, 1976. By Federal Register Notice of January 4, 1978, the U.S. Fish and Wildlife Service issued a final rule making establishing the procedural regulations governing interagency consultation under Section 7 of the Endangered Species Act of 1973. Accordingly, before the Department of the Interior, Bureau of Land Management would consider a new coal lease, it would consult with the Fish and Wildlife Service regarding potential impacts to endangered species or their habitats.

The following is a brief discussion, by region, of potential impacts on Federal endangered species. The main problem in the future regarding site-specific actions would be determination of whether or not an endangered species (either as a resident or an occasional migrant) or its habitat is present. Appendix Table D-4 lists the number of species by major category (i.e., mammals, birds, etc.) which occur on the state listings of protected species. Site-specific information would also be required to determine their presence.

TABLE 5-45

COMPARISON OF GAME ANIMAL LOSSES

COAL REGION	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1976 to 1985 Loss			Change from No New Leasing Value							
Northern Appalachian	18460	18110	18700	0	0	-50	-500	-510	-510	-10	-520
Central Appalachian	10300	11060	10330	0	-80	-170	-30	-50	-440	-90	130
Southern Appalachian	7810	10710	11180	0	-270	-40	-170	-150	0	-500	-340
Eastern Interior	15630	15780	15550	0	80	-150	-30	0	-120	-390	60
Western Interior	3980	4920	5040	0	-210	330	-260	-230	-300	0	720
Texas	10260	14270	13590	0	160	-1110	-100	-20	-800	-340	930
Powder River	2749	3410	4420	0	0	340	0	0	270	-10	-270
Green River-Hams Fork	1010	1650	2050	0	80	490	40	130	610	600	-270
Fort Union	1490	1780	3170	120	120	20	120	120	300	-210	330
San Juan River	40	50	80	0	0	0	0	0	10	10	10
Uinta-Southwestern Utah	260	280	320	40	10	10	10	10	20	10	10
Denver-Raton Mesa	340	460	560	0	20	20	20	20	80	120	20
	1986 to 1990 Loss			Change from No New Leasing Value							
Northern Appalachian	8555	9845	14280	5	10	205	-5	0	-20	40	60
Central Appalachian	5430	6530	7400	5	-65	-55	70	10	-25	-80	75
Southern Appalachian	3750	5710	7320	0	-20	430	50	5	90	-195	-270
Eastern Interior	7875	8529	9465	0	-110	0	90	-65	-380	-260	330
Western Interior	2010	3080	4635	0	-100	-350	-145	-15	-65	-105	-120
Texas	6455	13105	14605	35	-790	-1200	-240	-225	-1585	-1000	-335
Powder River	1710	2530	2675	0	590	1725	300	60	110	570	230
Green River-Hams Fork	755	955	1130	25	165	475	-10	20	410	405	-315
Fort Union	1080	1805	2390	0	105	-140	-25	20	85	-465	70
San Juan River	30	50	75	0	-5	0	0	0	0	0	5
Uinta-Southwestern Utah	175	175	225	0	-5	10	-120	-10	0	5	-10
Denver-Raton Mesa	270	360	410	0	0	40	10	-10	20	0	-20

TABLE 5-46

POTENTIAL THREATS TO ENDANGERED SPECIES OF COAL REGIONS

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
<u>FISHES</u>				
Woundfin	<u>Plagopterus</u> <u>argentissimus</u>	Virgin River below Hurricane, Utah	swift rivers	reservoirs
Greenback cutthroat trout	<u>Salmo clarki</u> <u>stomias</u>	Blackhollow Creek, Cache la Poudre River, few possible streams in Boulder & Larimer Counties, Colorado	fresh, cold streams & rivers	reservoirs
Arizona (apache) trout	<u>Salmo apache</u>	Arizona	streams	reservoirs
Humpback chub	<u>Gila cypha</u>	Green & Colorado Rivers, from Grand Canyon area northward to vicinity of Flaming Gorge Dam on Utah-Wyoming border	flowing streams & rivers	reservoirs
Colorado squawfish	<u>Ptychocheilus lucius</u>	Middle and lower Green River, main Colorado River above Lake Powell, and Salt River; spawning in Yampa and Green Rivers	turbid, swift warm rivers	reservoirs
Kendal Warm Springs dace	<u>Rhinichthys osculus</u> <u>thermalis</u>	Kendall Warm Springs, tributary to the Green River in Wyoming	warm springs fed streams	reservoirs
Fountain darter	<u>Etheostoma fonticola</u>	Comal & San Marcos Springs in Hays and Comal Counties Texas	spring out-flow	strip mining
Watercress darter	<u>Etheostoma nuchale</u>	Glen Springs at Bessemer, Jefferson County, Alabama (Black Warrior River drainage)	springs with watercress	highways, pipelines
<u>HERPTILES</u>				
Texas blind salamander	<u>Typhlomolge rathbuni</u>	Hays County Texas	deep wells, underground streams	probably none
Houston toad	<u>Bufo houstonensis</u>	Southcentral Texas	loblolly pine forests	strip mining
American Alligator	<u>Alligator</u> <u>mississippiensis</u>	North Carolina, South to Texas, Florida, Louisiana, Georgia, Arkansas, Southeast Oklahoma	Fresh wetlands, salty estuaries	habitat loss
<u>BIRDS</u>				
Eskimo curlew	<u>Numenius borealis</u>	Alaska, migratory through Central U.S.	grasslands and tundra	habitat loss

TABLE 5-46 (Continued)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Yuma clapper rail	<u>Rallus lonirostris yumanensis</u>	lower Colorado River; California, Arizona	marshes and sloughs	reservoirs
Whooping crane	<u>Grus americana</u>	winters on Gulf Coast, Texas; migrates through centralwestern U.S. from Canada to Texas	wetlands, coast, grain farmlands	probably none
Attwater's greater	<u>Tympanuchus cupido attwateri</u>	coastal prairie counties, Texas (primarily Refugio and Colorado Counties)	prairie, grasslands	strip mining
Arctic peregrine falcon	<u>Falco peregrinus tundrius</u>	Migrates through eastern and middle North America to Gulf	breeds in treeless tundra; migrates along coasts and waterways, feeds in marshes	habitat and wetland removal
American peregrine	<u>Falco peregrinus anatum</u>	breeds Alaska south to Baja Calif., Arizona to Rocky Mts. (most western states)	coniferous forests and wetlands and along rivers	habitat and wetland removal
Southern bald eagle	<u>Haliaeetus l. leucocephalus</u>	Atlantic & Gulf coasts, resident of Florida, may be found all over U.S. wandering	wetlands, cliffs, forests, estuaries, freshwater lakes	transmission lines, habitat removal
Mexican duck	<u>Anas diazi</u>	Arizona, New Mexico, Texas and Mexico	shallow ponds, wetlands	reservoirs
Red-cockaded woodpecker	<u>Dendrocopos borealis</u>	Oklahoma, Arkansas, Kentucky, Virginia-South to Gulf of Florida	mature pine forests	habitat removal
Ivory-billed woodpecker	<u>Campephilus p. principalis</u>	Texas, Louisiana	mature hardwoods	habitat removal
Bachman's warbler	<u>Vermivora bachmanii</u>	Virginia, South Carolina, Alabama	swamp forests bottomlands	habitat removal
Thick-billed parrot	<u>Rhynchopsitta pachyrhyncha</u>	Arizona & New Mexico	mountains	probably none
Kirtland's warbler	<u>Dendroica kirtlandii</u>	Breeding area-Lower Michigan, migrates south to Bahamas	Jack pines brushy undergrowth	probably none
<u>MAMMALS</u>				
Gray bat	<u>Myotis grisescens</u>	Central, Southeastern, Midwestern, and Eastern states	limestone caves	mining
Indiana bat	<u>Myotis sodalis</u>	Central and southeastern states	limestone	mining

TABLE 5-46 (Continued)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Black-footed ferret	<u>Mustela nigripes</u>	Western United States and Canada	shortgrass prairie	strip mining
Utah prairie dog	<u>Cynomys parvidens</u>	Utah	grassland & cropland	strip mining
Eastern cougar	<u>Felis concolor cougar</u>	Eastern United States (Canada to Carolinas)	remote woodlands and mountains	community expansion
Red wolf	<u>Canis rufus</u>	Texas, Louisiana (Gulf regions)	coastal prairie marshes, swamplands	community expansion
Mexican wolf	<u>Canis lupus baileyi</u>	Arizona, Texas and Mexico	remote arid	community expansion
Gray wolf	<u>Canis lupus monstrabilis</u>	Texas, New Mexico, Mexico	remote arid prairies	community expansion
Northern Rocky Mountain Wolf	<u>Canis lupus irremotus</u>	Wyoming, Montana, South Dakota (Black Hills), Idaho, Oregon and Washington	remote mountain regions & open lands & forests	community expansion
<u>CLAMS</u>				
Birdwing pearly mussel	<u>Conradilla caelata</u>	Powell & Clinch Rivers in Virginia and Tennessee; Duck River in Tennessee	river	reservoirs
Dromedary pearly mussel	<u>Dromus dromas</u>	Powell & Clinch Rivers in Virginia and Tennessee	river	reservoirs
Green-blossom pearly mussel	<u>Epioblasma torulosa torulosa</u>	Clinch River in Virginia and Tennessee	river	reservoirs
Tuberculed-blossom pearly mussel	<u>Epioblasma torulosa torulosa</u>	Lower Ohio River in Kentucky and Illinois, Nolichucky River in Tennessee and Kanawha River in West Virginia	river	acid drainage, reservoirs
Fine-rayed pigtoe pearly mussel	<u>Fusconaia cuneolus</u>	Clinch River in Virginia and Tennessee, Powell River in Virginia and Tennessee, and Paint Rock River in northern Alabama	river	reservoirs
Shiny pigtoe pearly mussel	<u>Fusconaia edgariana</u>	Powell and Clinch Rivers in Virginia and Tennessee, Paint Rock River in Alabama and Holston River in Virginia	river	reservoirs

TABLE 5-46 (Concluded)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Pink mucket pearly mussel	<u>Lampsilis orbiculata orbiculata</u>	Green River, Kentucky Kanawha River in West Virginia, Tennessee River (Tennessee and Alabama); Muskingum River, Ohio	river river	acid drainage, reservoirs
Alabama lamp pearly mussel	<u>Lampsilis virescens</u>	Paint Rock River System in Alabama	river	reservoirs
White warty-back pearly mussel	<u>Plethobasis cicatricosus</u>	Tennessee River in Tennessee and Alabama	river	reservoirs
Orange-footed pimpleback	<u>Plethobasis cooperianus</u>	Tennessee River in Tennessee and Alabama, Duck River in Tennessee	river	reservoirs
Rough pigtoe pearly mussel	<u>Pleurobema plenum</u>	Tennessee River, Tennessee, Green River, Kentucky; Clinch River, Virginia and Tennessee	river	acid drainage, reservoirs
Cumberland monkey-face pearly mussel	<u>Quadrula intermedia</u>	Powell and Clinch Rivers in Virginia and Tennessee Duck River, Tennessee	river	reservoirs
Appalachian monkeyface pearly mussel	<u>Quadrula sparsa</u>	Powell and Clinch Rivers in Virginia and Tennessee; Duck River, Tennessee	river	reservoirs
Pale lilliput pearly mussel	<u>Toxolasma cylindrella</u>	Duck river, Tennessee; Paint Rock River, Alabama	river	reservoirs
Cumberland bean pearly mussel	<u>Villosa trabilia</u>	Cumberland and Rock-castle Rivers, Kentucky	river	acid drainage, reservoirs
Yellow-blossom pearly mussel	<u>Epioblasma florentina florentina</u>	Duck River, Tennessee	river	acid drainage, reservoirs
Turgid-blossom pearly mussel	<u>Epioblasma turgidula</u>	Duck River, Tennessee	river	acid drainage, reservoirs
<u>Endangered Plants</u>				
Texas Wild Rice	<u>Zizania texana</u>	San Marcos River, Texas	warm spring-fed waters	habitat loss
Rydberg milk-vetch	<u>Astragalus perianus</u>	Utah	grasslands	habitat loss

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Northern Appalachian Coal Region. While Chapter 4 lists 26 species of endangered animals for Appalachia, few are actually permanent residents in the Northern Appalachian Coal Region. Much of this region is man-dominated and many species have already been extirpated. Reintroduction of the peregrine falcon is occurring in the Northeast, and it is possible that it could eventually spread to Northern Appalachia. Nesting habitat could be provided by rock outcrops and cliffs of Northern Appalachia, which would be impacted by mining. However, released birds are known to nest on man-made structures.

The gray and Indiana bats may be found in limestone caves, which could be affected by mining that removed the caves or impaired entrances. The southern bald eagle may wander north during the summer months. An occasional eastern cougar could be found in remote mountain areas. Because of the large territories established by this predator, any reduction of habitat either by mining, urbanization, or other conjunctive development would threaten the cougar.

No endangered plant species occur in the Northern Appalachian Coal Region.

Central Appalachian Coal Region. The statements for Northern Appalachia are also true for Central Appalachia. Since the Central Appalachian Coal Region is more remote, the potential for impacts to cougars and bald eagles would increase. As mountain tracts are stripped or opened to urbanization, these species might disappear. The gray and Indiana bat are less rare in Central Appalachia.

The rivers of the Central Appalachian Coal Region support 16 endangered mussels. These species could be threatened by mining which adds acid mine drainage or sediment to regional streams. In addition, reservoirs which change river habitat to lake habitat would eliminate some populations. The species residing in the following rivers would be most impacted by coal developments and industrialization: Powell, Clinch, Duck, Lower Ohio, Nolichucky, Kanawha, Holston, Muskingum, Green, Tennessee, Cumberland, and Rockcastle Rivers.

Southern Appalachian Coal Region. Three endangered bird species are found in the Southern Appalachian Coal Region. The southern bald eagle nests there, as well as the red-cockaded woodpecker and Bachman's warbler. All of these species are found in other southern states where coal development would not occur, so extinction would not occur if Southern Appalachia habitats were removed.

Conjunctive developments, such as roads, pipelines, plant construction, and urbanization, and sediment from land clearing, could reduce watercress darter populations. If Glenn Springs (Jefferson County, Alabama) were to be affected drastically as well, this species could become extinct.

The Paint Rock and lower Tennessee River systems support seven endangered clams. Sediment and reservoirs would reduce certain populations of these mussels.

Eastern Interior Coal Region. At least seven species of endangered animals are found in the Eastern Interior Coal Region. Few of these are permanent residents. The Arctic peregrine falcon migrates through this region along waterways. Southern bald eagles are found along the Mississippi River. The gray and Indiana bats are residents of

limestone cave areas, which could be negatively impacted by mining. Modification of caves would eliminate critical habitat.

Clams are also distributed in Eastern Interior Coal Region drainages, which would be affected by acid mine drainage and sedimentation.

Western Interior Coal Region. At least 10 endangered animal species are found within this region, and many more are unique to the Ozarks. In general, the coal regions do not extend to these limited habitats.

Southern bald eagles, whooping cranes, peregrine falcons, eskimo curlews, and Bachman's warblers are all migrants of this region. The red-cockaded woodpecker is a probable permanent resident in mature pine forest, particularly where suitable cavity trees exist (generally overmature pines infected with red heart disease). While development would not likely eliminate the species, population within this region would be reduced where development removed these forests.

Texas Coal Region. The Texas Region provides habitat for 13 endangered species. The fountain darter in Hays and Comal Counties, Texas, could be affected by water withdrawals, conjunctive developments or strip mining. If development were to eliminate Comal and San Marcos Springs, the fountain darter could become extinct.

The Houston toad could be eliminated from central Texas if pine forest were cleared and surface mined. The ivory-billed woodpecker may occur in mature bottomlands such as the Big Thicket. This bird and the red wolf would be affected if remote woodlands were altered.

Almost all Texas habitats provide potential feeding or nesting areas for some endangered species. The wetlands for the whooping crane are well protected, but the Mexican duck could be affected by water withdrawal activities which drain wetlands.

Drier prairie sites, which could be used for coal conversion and utilization plant sites or for strip mining, provide habitat for Attwater's prairie chicken. Prairie habitats and remote areas also support the Mexican and gray wolves. The greatest threat to the predators, however, would be the expansion of urban areas.

The San Marcos River provides habitat for Texas wild rice. Water withdrawals, sedimentation and water pollution would adversely affect this plant species.

Powder River Coal Region. At least five endangered species and one threatened species occur in this region. The whooping crane, bald eagle, and American peregrine falcon are all migrants of the region. Wherever prairie dog towns and resident black footed ferrets are found, surface mining, industrial development, or urbanization would lower or possibly cause loss of the ferret population. The threatened grizzly bear and endangered Northern Rocky Mountain wolf would be affected by activities in the remote hilly to mountainous areas on the western extreme of the region. Vast coal development and urbanization which remove open prairie habitat would probably move this species to the endangered list.

Green River-Hams Fork Coal Region. At least 10 endangered animal species are present in this coal region. The cold clear waters of the Green River system support the

humpback chub, Colorado squawfish and Kendal warm-springs dace. Reservoirs construction would reduce these species. Water withdrawal, thermal effluents from power or synthetic fuel production, or siltation from strip mining would also be harmful. The Cache la Poudre River should be protected due to the presence of the greenback cutthroat trout. Given the large amounts of water required for coal development, these fish species would be adversely affected by water withdrawals. (Introduction of more competitive species to increase recreational fishing would adversely affect this trout.)

The Utah prairie dog and black footed ferret are found in the Green River - Hams Fork Coal Region. As prairies are surface-mined and communities expand into remote areas, animal numbers would be reduced. The threatened grizzly bear would likely be returned to endangered status as urban and industrial areas expand. Omnivores such as the bear require large acreages for habitat, territory, and food.

Fort Union Coal Region. The Fort Union Coal Region is very similar to the Powder River Coal Region. In addition to species already mentioned, the Tule white-fronted goose would be impacted if development adversely affected critical lake or wetland habitats. The northern kit fox is an occasional wanderer into the region from Canada.

San Juan River Coal Region. In this region, the Arizona (Apache) trout would be affected by any water development, water withdrawals, reservoirs, or water pollution. The Yuma clapper rail would be adversely affected if water development caused wetlands to be altered or dried up along the Lower Colorado. The American peregrine falcon and Utah prairie dog are more dependent upon upland habitats which could be strip mined or subject to urbanization. The thick-billed parrot would probably remain unaffected by coal development since it exists principally south of the coal fields.

Uinta-Southwestern Utah Coal Region. This region has at least 10 endangered species. The woundfin, humpback chub, and Colorado squawfish are all associated with flowing river habitat and would be affected by reservoir construction, mining pollution, and water withdrawal.

Rydberg milk-vetch (threatened plant) would be adversely affected by strip mining and urbanization to other land clearing activities.

Denver-Raton Mesa Coal Region. At least five endangered species occur in this region. Whooping cranes, peregrine falcons, and southern bald eagles are migrants through the region. The black-footed ferret would be affected where strip mining and urbanization removed habitat or reduced prairie dog populations.

5.2.4 Socioeconomic Impacts

5.2.4.1 Population. Socioeconomic impacts are addressed in this section by analyzing the relationships between population changes that might be stimulated by coal management decisions and the baseline population data presented in the regional descriptions in Chapter 4. Population change is emphasized because it is one of the most important indicators of other kinds of change which often result in social and economic problems in communities affected by sudden

increases or decreases in coal production. The Department recognizes that the real impacts of Federal coal management decisions are felt directly by individuals and families. It also recognizes that some impacts are easier to measure than others. The change from stable rural environment to a more diverse and unpredictable setting, which combines both rural and urban activity, creates losses for some individuals which are real but difficult to quantify. Those losses are also the least likely to be avoided or minimized through mitigation.

Quantitative analysis can help predict the needs for housing, education, health care, utilities, public safety, recreational facilities, and other services and facilities required to assure that a population of a certain size can be accommodated in a specific area without causing overcrowded schools, inadequate health care, substandard living conditions from housing shortages, or similar problems. The cost of providing facilities and services can also be measured. This means that by analyzing the probable population impacts of alternative coal development proposals the State and local governments in impacted regions can work with local citizens, Federal agencies, and the coal industry to determine what kinds of facilities and services will be needed, where such facilities and services should be located, when they are needed, and who should pay for them.

Where data in this section indicate large population changes or rapid population growth rates, social and economic problems would likely result unless corrective actions are planned by responsible State and local governments. The possible impacts of such changes can be further measured by comparing the socioeconomic data in Appendix G with the regional descriptions in Chapter 4. The comparison will illustrate the range of facility and service demands which could be generated by population changes.

Population changes might occur in any of several specific locations within a broad geographic area, and regional data can not be used to predict impacts on an individual community or locale. Only a more project-specific and site-specific analysis could provide information of meaningful value to local planners. The impact of rapid increases in coal-related employment will also vary greatly from community to community, depending on the level of existing services and facilities in specific areas. A given amount or rate of mining-induced demand for services would have one effect in an area that is already relatively industrialized, compared to the impact of introducing the same demand in a predominantly agricultural area. For this reason, increases in demand for specific facilities and services can not necessarily be considered as an economic threat, or an economic benefit, without more specific analysis of local conditions and capabilities.

In general, social and economic change can be projected to have different impacts, requiring consideration of different mitigation measures, in three broad categories of impacted communities. In areas that have previously experienced industrial development, and that have both private and public facilities and services in place to support an existing urban or industrial population, an increase in mining and related activities may lead to increased occupancy of existing housing, increased employment among existing local or area workers, higher enrollment in existing schools, and corresponding increases in the use of other facilities and services. Population

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changes from the increased activities, in terms of both absolute numbers and relative to the community's existing population, may be minimal. Where changes would take place, local and state government agencies with existing budgets and staffs designed to deal with social services, planning, and land use can address the population-related problems; in these cases, the need to increase the size and complexity of local government might be minimal.

However, where neither the private economy nor local governments have previously been required to respond to needs created by relatively large numbers of industrial workers, the changes required may seriously conflict with existing patterns of residential and commercial development, transportation systems, and priorities for government activity and spending. Some problems would be physical and financial, others more social and political. The need to decide where to develop new housing, the need to protect community health and safety by building new sewage treatment plants and hiring more police and fire employees, requirements for new school buildings and more teachers, could put strains and pressures on the resources of a small community. A sharp increase in demand for building sites, construction materials, and other goods and services could cause serious local inflation. New employees in mining-related industries would usually be more highly paid than the established residents who work in other enterprises, which could mean that people who have lived in a community for years may find themselves paying more to live, without a commensurate increase in personal income. The need to find public funds to pay for roads, sewers, schools, and other government services may also increase the tax burden for all local residents, particularly where tax collections from the new industry and its workers would not bring in new revenues fast enough to finance the new services and facilities needed. Increased use of public roads by mining or industrial equipment may increase repair and maintenance costs, thus posing serious problems of planning and financing for local authorities.

A municipal or county government which has not previously had to address such questions may be forced to consider substantial changes in budget, structure, and priorities. The process of considering serious changes in the size, cost, and authority of local government may cause considerable social and political conflict within a community.

The third category of impacted communities includes those areas so far removed from existing communities that, with the exception of often unsurfaced rural roads and occasional general stores, only the most minimal commercial or government facilities and services exist. Residents make infrequent trips to distant urban centers for most supplies and materials. Medical care, commercial entertainment, and other services available only in larger communities are equally distant. Self-reliance, and interdependence among neighboring families, establishes community relationships which provide cooperative approaches to dealing with common problems. Rather than feeling isolated or deprived, many residents of such rural areas are satisfied with the quality of their lives, and feel threatened by changes that would result from the introduction of mining and industrial development in their areas. Others who welcome employment and other economic opportunities that could be generated by coal development retain, at the same time, a strong interest in

maintaining what they consider to be the benefits of life in a rural, agricultural area. Few residents of these rural areas, even among that segment of the population which favors coal development, want development to take place in a manner which would seriously disrupt traditional community values and patterns.

Introduction of mining-induced populations into such areas would have significant social and economic consequences. The goal of maintaining a physical and social environment consistent with tradition is not realistic. Residents who cherish this way of life would be forced to tolerate changes. At the same time, because there are few existing financial and institutional commitments to housing, transportation, and government services, these facilities and services could be designed and installed without causing the conflicts and disruption which could result from trying to match the new needs to existing private and public support existing in an established community. The benefit of being able to avoid such temporary social and financial conflict by locating new communities in undeveloped areas may be offset, however, by the higher economic costs of building a complete new community in a remote and undeveloped area.

Basically, the degree of impact would be directly related to the incremental growth of the area. Communities in semirural areas could generally absorb a five percent annual growth rate without experiencing severe strain. However, rapid urban growth or "hyperurbanization" could occur if average annual increases approached the seven to 10 percent range, i.e., boom-town development. Population growth rates above 10 percent would require detailed advance planning and possible considerations of new town designs. If growth rates exceed the hyperurbanization levels, many of the impacts discussed above would likely intensify. Quantification of population change in the following discussion should, therefore, be related to these ranges of growth. It should be noted, however, that the following analysis assumes a straight line growth rate of the total population. It does not reflect the specific variations between types of coal related activities nor does it reflect short-term growth fluctuations. For example, the different impacts which would result from the rapid rise and fall of a labor force required for the construction of a steam electric power plant as opposed to the long-term build-up of operational related populations are not addressed separately. The total population discussed in the remainder of this section is derived from both the construction and operational workers for all phases of the coal cycle which includes the direct workers and their families as well as the indirect or service sector related population.

The total population related to the no new leasing alternative is presented in Table 5-47 for the low, medium, and high coal production projections. Data shown for 1985 represent the change in coal related population that could occur between 1976 and 1985. More specifically, it is the difference between the population which existed as a result of coal related activity in 1976 and the population related to coal production and consumption levels projected for 1985. It is this change in coal related population over time, compared to the regional baseline populations shown in Table 5-47, that provides the basis for addressing population growth rates and the significance of socioeconomic impacts. Similarly, the 1990 numbers represent coal related population changes that could

TABLE 5-47

COAL RELATED POPULATION ASSOCIATED WITH NO NEW LEASING ALTERNATIVE
(thousands)

REGION	1975 BASELINE ^(a)	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
		1985 ^(b)	1990 ^(c)	1985 ^(b)	1990 ^(c)	1985 ^(b)	1990 ^(c)
Northern Appalachian	8,019.5	123.6	-12.6	137.3	108.4	149.2	374.2
Central Appalachian	2,070.0	14.9	18.3	30.5	76.9	-6.8	193.4
Southern Appalachian	2,289.6	37.7	-2.2	88.0	26.7	116.7	87.4
Eastern Interior	5,191.7	176.2	158.8	185.0	263.6	157.3	392.7
Western Interior	5,883.1	65.8	16.2	99.8	150.4	106.1	216.5
Texas	2,526.6	121.8	57.2	182.3	259.4	176.7	328.1
Powder River	228.4	79.7	31.7	112.3	91.1	157.4	56.3
Green River-Hams Fork	126.9	21.1	25.1	45.4	24.0	58.6	19.4
Fort Union	324.4	14.7	21.8	22.4	60.2	51.8	51.9
San Juan River	351.1	5.9	18.6	12.8	44.3	30.3	59.2
Uinta-Southwestern Utah	406.6	21.2	22.3	42.2	37.1	66.0	49.4
Denver-Raton Mesa	1,854.2	16.0	23.9	25.6	38.7	36.1	37.4

(a) 1975 baseline population from regional description in Chapter 4.

(b) Change in coal related population between 1976 and 1985.

(c) Change in coal related population between 1985 and 1990.

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take place between 1986 and 1990. Additionally, the numbers do not necessarily mean that regional populations would increase or decrease by these magnitudes. The numbers are directly related to employment associated with coal cycle increases and represent positions which might be filled by unemployed or under-employed workers within the region or new local entries into the labor market. In situations of this type, little if any population influx would occur. This is the probable case in Appalachia where coal related population increases would comprise a very small part of the total regional population base. Conversely, when these increases would be significantly greater than the baseline population, as in the Powder River Coal Region, considerable in-migration of workers and their families would be probable. While detailed socioeconomic impact analysis must be conducted on a more site-specific level, the relative magnitudes of the coal-related populations and regional baseline populations presented here are indicative of potential impacts at the regional level.

Socioeconomic impacts of the no new leasing alternative are greatest in the Powder River Coal Region for the low, medium, and high production projections for both time periods. Population related to the 1985 production level would range from approximately 80,000 for the low projection to about 157,000 for the high projection (see Table 5-47). This represents 35 to 69 percent of the 1975 regional baseline population of about 228,000. Comparable numbers for the 1990 time period for the medium production projection are approximately 91,000, or about 40 percent of baseline. A total change of 89 percent over the 15-year period from 1975 to 1990 would result for the medium production projection.

Associated with these population data are comparable impacts on other socioeconomic characteristics as shown in Appendix G. For example, the 157,000 people at the 1985 high production projection in the Powder River Coal Region relates to approximately 35,000 public school children and 52,000 housing units. This compares to baseline figures of 54,000 enrollments and 82,000 year-round dwellings, or about a 65 percent increase over baseline for that time period. Also, while there were only an estimated 257 patient care physicians in the entire Powder River Coal Region in the base year, coal related demand for doctors would reach approximately 160 at the 1985 high production projection. Requirements for 330 law enforcement officers compares to a base force of about 550.

It is apparent that coal related population in the Powder River Coal Region would reach levels at which hyperurbanization would likely occur during both time periods under the no new leasing alternative.

Although some of the absolute population figures shown in Table 5-47 would reach considerable levels in other regions under the no new leasing alternative, their relative magnitudes do not appear significant when compared to baseline populations. There are also significant differences between the program alternatives which cannot be analyzed quantitatively at this level of aggregation. For example, although the no new leasing alternative data may in some cases suggest lower levels of impact when compared to other alternatives, the distribution and timing of related population influx within the region could result in more severe problems. Demand for coal would require significant levels of production and

consumption even without additional Federal coal leasing. Leasing might encourage changes in the rate and location of this activity away from areas least capable of accommodating the development.

For example, under the no new leasing alternative, the future unavailability of new Federal coal would accelerate development of other coal reserves in a region. As a general proposition, a coal company develops its resources by choosing to mine the most profitable reserves it owns. The Federal Government, on the other hand, directly and indirectly controls vast amounts of western coal reserves. In developing future regional production targets and in acting on mine plans for existing leases, the Department of the Interior has the ability to encourage the development of those reserves which best balance energy needs with other social, environmental, and economic values and objectives.

Another consideration is the degree to which the ability of local communities to react to infrastructure demands related to accelerated coal development is considered in future coal management decisions. The preferred program would include establishment of formal procedures for the exchange of information, concerns, and desires between the Department of the Interior and state and local agencies. The planning elements of the preferred program are also incorporated into the lease PRLAs only, short-term leasing, and meet DOE production goals alternatives. While the extent of any new Federal leasing would vary among these alternatives, the ability to recognize and minimize associated economic dislocations could be assured. The state determination of leasing levels would achieve similar results, but with many management responsibilities transferred from the Federal Government to the states.

Comparing the no new leasing alternative to the other six alternatives provides insight into the relative magnitude of impacts between alternatives. Data in Table 5-48 show the coal-related population increase related to the no new leasing alternative and compare the increases which would result under the other alternatives to that level. Positive numbers shown for the other alternatives indicate a higher level of coal-related population change than under the no new leasing alternative; negative numbers indicate a lower level.

The preferred program medium level in the Powder River Coal Region reflects a population change of approximately 71,000 over the no new leasing alternative. This amounts to an increase of about 162,000 people over the baseline population of 228,000 or an annual growth rate of approximately 14.2 percent. While adverse socioeconomic impacts would arise if there were no new leasing, they would be more severe if demand for more production reached levels that could only be met through additional leasing.

There are also several other alternatives which suggest severe problems in the Powder River Coal Region under the 1990 projections. While the no new leasing alternative reflected an annual growth rate of about 8.0 percent, the lease PRLAs only, lease to meet industry needs, and lease to meet DOE production goals would each stimulate growth above that level. These alternatives would result in annual population growth rates of approximately 11 percent, 16 percent, and 14 percent, respectively. Population changes related to these alternatives would be considerably higher than the no leasing alternative.

TABLE 5-48

COAL RELATED POPULATION, COMPARISON OF
COAL MANAGEMENT ALTERNATIVES
(thousands)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DEFER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	123.6	137.6	149.2	-	-0.2	-1.0	-10.0	-10.0	-10.6	-0.2	-10.7
Central Appalachian	14.9	30.5	-6.8	-0.1	-2.0	4.6	-0.3	-1.3	-18.1	-3.1	7.6
Southern Appalachian	37.7	88.0	11.7	-0.1	-4.2	-3.0	-3.6	-2.0	5.7	-13.9	-10.5
Eastern Interior	176.2	185.0	157.3	-0.1	3.9	-13.5	-0.7	0.7	-12.1	-8.0	7.5
Western Interior	65.8	99.8	106.1	-0.2	-5.9	10.3	-7.6	-6.5	-6.5	0.7	21.4
Texas	121.8	182.3	176.7	0.1	2.0	-14.0	-1.5	-0.4	-9.1	-4.1	11.9
Powder River	79.7	112.3	175.4	-	0.6	15.5	0.1	0.3	13.1	0.1	-11.7
Green River-Hams Fork	21.1	45.4	58.6	-	3.3	18.2	1.3	0.7	22.3	21.8	-9.8
Fort Union	14.7	22.4	51.8	2.6	2.7	0.7	2.8	2.8	7.0	-4.1	-7.0
San Juan River	5.9	12.8	30.3	-	0.2	0.3	-0.1	-0.1	3.4	-3.5	4.5
Uinta-Southwestern Utah	21.2	42.2	6.0	-	1.0	1.1	0.5	0.4	8.1	-3.8	0.4
Denver-Raton Mesa	16.0	25.6	36.1	-	1.2	0.8	1.1	1.1	3.0	5.0	2.1
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	-12.7	108.4	374.2	-8.4	2.0	-1.9	13.0	13.4	12.2	6.7	25.3
Central Appalachian	18.3	76.9	193.4	0.7	-5.4	-17.4	2.2	-0.3	8.6	-5.0	10.5
Southern Appalachian	-2.2	26.7	87.4	-0.4	3.7	17.3	6.7	3.1	4.9	-8.7	-17.4
Eastern Interior	-158.8	263.6	392.7	-0.3	-22.2	-40.5	-27.2	-7.7	-57.6	-11.0	66.4
Western Interior	16.2	150.4	216.5	1.2	-0.5	-45.5	-2.9	1.0	1.6	-11.5	-0.1
Texas	57.2	259.4	328.1	-0.7	-26.4	-13.2	-7.4	-8.4	-37.0	-24.8	-28.8
Powder River	31.7	91.1	56.3	0.7	71.3	186.7	35.6	6.9	93.3	69.5	-11.4
Green River-Hams Fork	25.1	24.0	19.4	3.4	12.3	23.9	-1.6	0.3	10.7	10.0	-15.6
Fort Union	21.8	60.2	51.9	-3.6	-9.6	-7.7	-5.3	-2.8	-3.8	-20.2	-5.7
San Juan River	18.6	44.3	59.2	1.1	-7.0	-0.9	-2.7	-0.7	-2.8	-5.1	-2.4
Uinta-Southwestern Utah	22.3	37.1	49.4	2.1	-9.0	-5.7	-7.9	-2.6	-2.4	26.7	-13.2
Denver-Raton Mesa	23.9	38.7	37.4	1.0	-2.2	22.5	-2.5	-2.7	-6.0	-18.4	-6.7

(a) Represents change in coal related population between 1975 and 1985 and between 1985 and 1990.

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In summary, the Powder River Coal Region would experience the greatest socioeconomic impacts for the no leasing alternative for both the 1985 and 1990 forecasts. These impacts would be even more severe in 1990 if production is increased to levels for the lease PRLAs only, lease to meet industry needs and lease to meet DOE production goals alternatives. Data indicate that population growth rates in the Powder River Coal Region would reach levels for these alternatives where hyperurbanization is probable; the variety of adverse socioeconomic impacts discussed earlier would be likely. While growth rates in other regions appear to be within manageable levels, any concentration of population change in the more sparsely populated areas of the western regions would have the potential for similar adverse impacts.

5.2.4.2 Employment Impacts. The increased production and use of coal would create more jobs. The rate of increase in coal-related employment would depend on the level of total energy demand, and the percentage of that demand supplied by coal-using facilities. Increases would be for jobs needed to mine, beneficiate (crush, grind, wash, and otherwise treat coal to make it usable), transport, and use coal.

Whether from surface or underground mining, increased coal production would result in significant new demands for labor. While all coal mining creates jobs, fewer jobs are created by surface mining than by underground mining, because the massive draglines and shovels used in surface mining require much less labor for each ton of coal recovered than do the smaller and less productive machines used in underground mining. Although demand for labor would increase in all parts of the country where coal is mined, and the greatest growth rate in the coal mining industry is expected to take place in the western states (where coal mining now occurs at a relatively low level), the resultant increase in western demand for coal miners is not expected to cause a significant westward migration of mine workers. Increasing employment opportunities in eastern and midwestern mines, the high percentage of eastern miners trained in underground mining skills different from those required in those western surface mining regions experiencing high growth rates, and reluctance to give up established homes and living patterns in the east for difficult new living conditions in western coal "boom towns," would cause many eastern miners, even underemployed or unemployed mine workers, to remain in their established communities.

The principal source of labor for western coal production would be western workers in agriculture, and, to some degree, the construction industry. Workers skilled in heavy equipment operation could easily transfer their skills to surface mining. Operators of small farms and ranches may supplement their incomes by working part time in the mining industry. It is expected that many agricultural workers would respond to the higher income opportunities created by coal mining, and so reduce the supply and increase the cost of agricultural labor. However, the severity of economic conflicts between the needs of agriculture and the needs of coal-related employers cannot be accurately predicted without more specific information about individual projects, rates of growth, and whether jobs are filled by local workers or by workers who have migrated into the region to seek employment in the coal industry.

Impacts of the high employment demands of coal-using facilities would vary according to the location of the power plants, gasification or liquefaction plants, and other facilities. For several reasons, it cannot be assumed that coal-based energy facilities would be located near the mines which supply them. Utilities which once planned to build mine-mouth power plants in the inter-mountain West to provide electricity for distant consumers are now considering advanced technologies. This could result in coal being transported by rail or slurry to conversion plants located in or near the major energy consumption centers. The relative scarcity of water in those western states with abundant coal supplies, and the desire of those states to ensure that their own industrial growth potential is not limited by pollution from plants which export power elsewhere, are stimulating more interest in techniques for converting coal in plants close to the industries and the consumers who use the coal-based energy. These factors, and uncertainty about which new technologies and which coal feedstocks would be used in the manufacture of coal-based synthetic fuels, mean that assumptions of national demand for those products cannot be translated into specific projections showing where the conversion plants and employment demand would be located. Because of the specialized construction and operational skills required, it can be expected that to the degree conversion plants are located in remote rural areas or near communities without an existing industrial workforce, significant interregional population movement would occur, as described in section 5.2.4.1.

Because coal transportation systems are not labor intensive, employment growth to transport coal would not be as dramatic as for mining or use of coal. Overall numbers of coal transportation jobs are not likely to be changed by alternative systems, although the selection of rail, slurry, or waterway transport could affect the location of job opportunities. A secondary consequence of transporting coal by truck, the need for significant increases in road repair, may create substantial localized demands for public works maintenance workers.

Projected employment increases in 1985 and 1990 under the no new leasing and other coal management alternatives are presented in Tables 5-49 through 5-54 on the basis of employment type (construction or operation), and by major phase of the coal cycle (mining, beneficiation, conversion, or use).

Estimates for construction employment in the coal mining and beneficiation phase are presented in Table 5-49 for the low, medium, and high production projections in 1985 and 1990 for the no new leasing alternative. Current (1976) coal-related employment is also presented. In 1985, employment in this phase of the coal cycle is projected to increase by 21 to 33 percent (low to high production projections) over 1976 levels. Major increases in the eastern regions are projected to occur in the Eastern Interior Coal Region (26 to 41 percent increase over 1976 levels) and in the Texas Coal Region (108 to 156 percent increase over 1976 levels). In the western regions, a substantial increase in construction employment is projected in the Powder River Coal Region for all production levels. Medium and high production projections would cause substantial construction employment increases in the Green River-Hams Fork Coal Region (85 to 123 percent), San Juan River Coal Region (82 to

TABLE 5 - 49

NO NEW LEASING ALTERNATIVE, COAL MINING AND BENEFICIATION EMPLOYMENT
CONSTRUCTION WORKERS

COAL REGION	CHANGE						
	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985- 1976	1990- 1985	1985- 1976	1990- 1985	1985- 1976	1990- 1985
Northern Appalachian	61,235	5,501	3,682	6,019	3,023	6,915	13,299
Central Appalachian	70,380	447	3,035	785	1,161	3,540	15,105
Southern Appalachian	8,045	838	465	727	173	3,178	111
Eastern Interior	44,338	18,415	23,084	17,865	39,763	11,337	59,520
Western Interior	3,089	312	50	473	2,378	562	9,787
Texas	3,652	5,532	2,212	5,716	10,570	3,955	20,112
Powder River	9,727	12,538	4,720	18,640	18,849	26,520	11,319
Green River-Hams Fork	6,806	1,728	5,020	5,757	4,454	8,366	3,823
Fort Union	2,508	386	782	1,793	2,998	3,670	6,823
San Juan River	2,525	814	4,615	2,069	10,553	3,996	11,141
Uinta - Southwestern UT	3,891	819	3,404	3,278	5,861	5,793	6,311
Denver-Raton Mesa	602	19	2,827	440	3,664	1,140	2,938

TABLE 5-50

COMPARATIVE PROJECTIONS
COAL MINING AND BENEFICIATION CONSTRUCTION EMPLOYMENT

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA'S ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	73,923	75,122	77,153	31	-30	-278	24	-9	-449	-64	-211
Central Appalachian	71,523	72,260	62,492	0	-331	-921	28	-202	-4169	-615	1771
Southern Appalachian	6,221	9,720	15,214	0	-329	-747	-359	6	1442	-1869	-1625
Eastern Interior	84,683	83,529	69,160	0	1256	-4622	-59	346	-4426	-1000	2595
Western Interior	3,799	4,208	4,379	-37	-209	17	-170	-27	-1691	-988	439
Texas	16,207	16,623	12,624	26	598	-3456	-79	146	-3583	-1637	3785
Powder River	38,268	52,165	70,085	0	345	6593	52	148	5470	247	-4987
Green River-Hams Fork	10,742	19,912	25,851	0	1078	7692	551	272	9094	9094	-4556
Fort Union	3,447	6,728	11,097	0	0	0	0	0	1092	-2186	1203
San Juan River	4,363	7,173	11,515	0	65	96	0	0	1481	-797	2037
Uinta-Southwestern Utah	5,718	11,268	16,954	0	129	163	119	33	2032	-1237	-66
Denver-Raton Mesa	640	1,599	3,198	0	0	0	0	0	312	312	636
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	69,104	79,402	95,410	0	144	-3276	-108	-26	-692	851	2045
Central Appalachian	67,540	74,055	83,263	-34	-1581	-6576	-223	-380	-2772	-1779	4534
Southern Appalachian	5,600	9,521	15,417	0	-359	-835	-16	-6	1433	-4325	-4395
Eastern Interior	115,816	137,194	148,821	-437	-4354	-30310	-7318	-1287	-18151	-5055	19514
Western Interior	3,830	7,567	17,925	-122	-2470	-13473	-1774	-365	-4342	-4510	2558
Texas	19,219	31,015	40,008	-259	-8650	-14033	-777	-936	-15705	-10339	-2193
Powder River	44,705	77,871	85,519	48	15110	69390	12519	2889	37981	24106	-8482
Green River-Hams Fork	17,590	26,091	31,089	960	5452	14143	705	1411	12965	12838	-8868
Fort Union	4,541	10,911	20,603	0	-1997	-2931	-796	-89	188	-6238	735
San Juan River	10,207	20,911	26,028	295	-2343	-282	-879	-173	581	-4320	1454
Uinta-Southwestern Utah	10,003	18,987	25,468	317	-1817	-1740	-1322	-49	1321	-8369	-2165
Denver-Raton Mesa	4,153	6,240	6,936	295	158	410	343	81	-667	-3818	187

TABLE 5-51
 NO NEW LEASING ALTERNATIVE
 COAL MINING AND BENEFICIATION EMPLOYMENT
 OPERATIONAL WORKERS

COAL REGION	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985- 1976	1990- 1985	1985- 1976	1990- 1985	1985- 1976	1990- 1985
Northern Appalachian	101,184	37,332	-2,415	40,335	16,975	44,291	46,860
Central Appalachian	105,054	4,315	-3,616	5,909	6,195	-8,359	35,148
Southern Appalachian	14,932	-2,131	-749	4,767	738	15,871	2,333
Eastern Interior	51,337	38,112	37,236	37,743	63,784	24,182	87,747
Western Interior	3,994	382	81	892	3,768	965	14,878
Texas	2,092	7,200	1,728	7,437	8,252	5,143	15,701
Powder River	6,005	17,849	3,998	26,515	15,986	37,696	9,588
Green River-Hams Fork	4,380	3,689	4,263	9,269	5,516	12,720	4,928
Fort Union	1,462	612	638	2,524	2,441	5,078	5,528
San Juan River	1,565	1,658	2,412	3,349	7,165	6,649	7,130
Uinta - Southwestern Utah	5,249	1,743	2,664	8,526	7,958	15,550	10,111
Denver-Raton Mesa	11,128	-143	2,059	1,322	4,133	3,773	3,523

TABLE 5-52

COMPARATIVE PROJECTIONS
COAL MINING AND BENEFICIATION OPERATIONAL EMPLOYMENT

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	138,517	141,513	145,474	58	-55	526	41	-16	-849	-122	-407
Central Appalachian	109,367	110,965	96,695	0	-574	-1534	45	-341	-6900	-1092	2911
Southern Appalachian	12,802	19,704	30,804	0	-661	-1512	-727	19	2921	-2814	-3278
Eastern Interior	89,441	89,076	75,517	0	1485	-5062	-59	418	-4510	-1169	2827
Western Interior	4,377	4,855	4,956	-37	-209	74	-189	-19	-2019	-1153	554
Texas	9,292	9,533	7,238	17	343	-1983	-45	86	-2052	-939	2172
Powder River	23,852	32,532	43,699	0	144	4058	31	69	3333	82	-3204
Green River-Hams Fork	8,066	13,654	17,105	0	780	4909	449	196	5809	5809	-2757
Fort Union	2,073	3,989	6,542	0	0	0	0	0	638	-1277	700
San Juan River	3,224	4,910	8,217	0	70	98	0	0	910	-626	1210
Uinta-Southwestern Utah	6,992	13,774	20,798	0	155	198	115	38	2474	-1518	-77
Denver-Raton Mesa	986	2,448	4,901	0	0	0	0	0	14	14	737
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	136,099	158,495	192,333	0	279	-6518	-216	-52	-1340	1608	3952
Central Appalachian	105,754	32,139	133,843	-55	-2738	-11057	-379	-645	-4798	-3115	7791
Southern Appalachian	12,051	23,444	33,137	0	-775	-1836	-40	-23	3064	-9245	-9422
Eastern Interior	126,676	152,861	163,264	-463	-5299	-33176	-8013	-1556	-21264	-7872	22576
Western Interior	4,454	8,656	19,838	-136	-2846	-14974	-2101	-425	-5114	-5223	3097
Texas	11,021	17,781	22,941	-148	-4961	-8047	-446	-538	-9007	-5928	-1258
Powder River	27,850	48,521	53,290	19	15439	42999	7860	1780	23433	14815	-5450
Green River-Hams Fork	12,331	19,168	22,033	718	3679	9115	713	960	8394	8315	-5314
Fort Union	2,712	6,429	12,070	0	-1164	-1690	-464	-50	113	-3641	430
San Juan River	5,633	12,072	15,345	67	-1577	-294	-722	-157	178	-1222	701
Uinta-Southwestern Utah	9,658	21,731	30,910	144	-2450	-2361	-1466	-89	2229	-8367	-3665
Denver-Raton Mesa	3,041	6,580	8,424	67	-421	94	-50	52	-1639	-3026	-300

TABLE 5-53

NO NEW LEASING ALTERNATIVE
COAL CONVERSION AND UTILIZATION EMPLOYMENT
CONSTRUCTION WORKERS

COAL REGION	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985- 1976	1990- 1985	1985- 1976	1990- 1985	1985- 1976	1990- 1985
Northern Appalachian	123,485	5,979	4,874	4,553	20,040	6,106	86,028
Central Appalachian	46,116	-411	12,667	2,945	21,737	3,141	30,092
Southern Appalachian	38,995	14,995	-341	27,014	7,907	26,337	30,166
Eastern Interior	89,842	16,310	10,697	18,975	11,252	23,036	21,485
Western Interior	34,090	21,262	5,366	32,133	51,099	33,612	58,371
Texas	14,854	33,581	19,131	55,092	87,312	55,638	97,848
Powder River	5,741	4,778	5,146	4,778	2,445	5,786	2,400
Green River-Hams Fork	7,935	3,089	2,057	4,330	-993	4,330	-960
Fort Union	10,678	2,729	6,924	1,642	18,166	9,473	6,795
San Juan River	7,860	34	1,459	170	1,236	2,568	7,949
Uinta-Southwestern Utah	3,389	6,180	3,763	6,221	2,160	7,028	5,148
Denver-Raton Mesa	4,171	4,970	5,244	6,684	7,292	7,221	5,908

TABLE 5-54
NO NEW LEASING ALTERNATIVE
COAL CONVERSION AND UTILIZATION EMPLOYMENT
OPERATIONAL WORKERS

COAL REGION	1976	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	BASELINE	1985- 1976	1990- 1985	1985- 1976	1990- 1985	1985- 1976	1990- 1985
Northern Appalachian	29,422	3,657	-579	5,551	3,264	3,271	18,122
Central Appalachian	5,594	-400	1,735	372	2,976	408	4,399
Southern Appalachian	6,718	4,030	65	6,509	1,851	6,701	5,082
Eastern Interior	15,381	6,338	2,657	7,092	4,164	9,011	8,278
Western Interior	3,967	4,769	1,013	7,342	7,755	7,587	10,027
Texas	1,913	8,014	3,024	13,298	11,914	13,382	15,546
Powder River	655	1,090	703	1,090	3,893	1,920	591
Green River-Hams Fork	917	737	291	977	1,366	977	-132
Fort Union	1,217	1,706	1,493	2,494	2,736	3,645	2,229
San Juan River	898	7	199	38	1,534	586	1,087
Uinta - Southwestern UT	1,039	727	516	1,148	797	1,845	686
Denver-Raton Mesa	842	1,353	751	1,694	1,318	2,086	2,461

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158 percent), and Uinta-Southwestern Utah Coal Region (84 to 149 percent).

By 1990, the high growth rates observed in the earlier periods would generally decrease. Western coal mine and beneficiation plant construction is projected to increase an additional 21,000 to 42,000 jobs over 1985 estimates. This represents a national increase in construction employment in the mining and beneficiation sector of approximately 10 percent. The primary reason for the decline in the demand for construction workers is that the rate of coal production growth would be generally higher between 1976 and 1985 than it would be between 1986 and 1990. By 1990, western coal use would reach high absolute levels and relative increases, although still representing substantial new production, would be smaller.

Projected levels of construction employment in the mining and beneficiation sector for all other program alternatives are presented in Table 5-50. In 1985, major variations from employment levels for the no new leasing alternative are projected in the Eastern Interior, Powder River, Green River-Hams Fork and San Juan River Coal Regions. By 1990, program alternatives would cause only minor variations in regional employment levels.

Employment projections for operation in coal mining and beneficiation are presented in Table 5-51. The data indicate the additional employment (in excess of 1976 baseline estimates) projected under the various no new leasing production levels for 1985 and 1990. Major increases are projected to occur in the Northern Appalachia, Eastern Interior, Texas, Powder River, Green River-Hams Fork, and Uinta-Southwestern Utah Coal Regions. The number of workers needed in the western regions would be fewer than those required for the labor intensive eastern mines, but the socioeconomic changes caused by the new western coal-related employment would be more significant. This would occur because of the relative shortage of industrial workers in western mining regions.

Table 5-52 presents the level of projected increase or decrease from baseline conditions for each of the other program alternatives analyzed. As with the level of construction workers projected to accompany each alternative, the number of additional operational workers projected is dependent on both the baseline level of coal cycle employment and the rate of projected coal production increases.

Estimates of the 1976 construction employment in coal-using facilities indicate approximately 387,000 workers are employed in this phase of the coal cycle. By 1985, demand for an additional 230,000 workers is projected. Projections of construction employment, in 1985 and 1990, at the low, medium, and high production levels for the no new leasing alternative are presented in Table 5-53. Analysis of projected construction employment in this phase of the coal cycle for other program alternatives indicates that no substantial variations are projected to occur by either 1985 or 1990.

As shown by Table 5-54, development of new coal using facilities and an increase in the number of workers employed in such facilities would occur, even if no additional Federal coal reserves are leased. The 69 percent increase shown for 1985 reflects a nationwide surge in construction of new combustion facilities, and the data assumes the possibility of

subsequent development of significant numbers of coal-based synthetic fuels plants by 1990. As noted earlier, neither the number nor the geographic distribution of synthetic fuels plants can be reliably projected, principally because of uncertainties about economic and technological factors which would influence the development of the synthetic fuels industry.

5.2.4.3 Agriculture. The adoption of any of the program alternatives could influence coal development on lands which are presently used for agricultural purposes. Surface mining, right-of-way construction, and power plant construction are coal-related activities that could require the use of agricultural lands. Without knowing the specific agricultural tracts, if any, which may be disrupted by program-related coal development, this agricultural impact analysis is necessarily limited to a general discussion.

Table 5-55 provides an interregional comparison of agricultural values using the no new leasing alternative as a basis. Dollar values were determined from average value of all crops per acre times estimates of potential cropland for each region. While actual values and acres may vary, Table 5-55 provides a means for general interregional comparisons of agricultural impact. In addition, estimates of potential agricultural production loss for the program alternatives are presented in Appendix D, Tables D-5 through D-26.

In general, the relatively larger impact measures in the Appalachian, Eastern Interior, Western Interior, and Texas Coal Regions are a function of more eastern land being devoted to cropland with a higher productivity value per acre than in the western regions.

The amount of land allocated to cropland for regional comparative purposes does not necessarily imply that a similar amount of prime farmland exists. This can only be determined after soil surveys designating prime farmlands are completed. Once actual mining sites are identified and surveyed for prime farmland, specific options for mining would be available. Impacts on prime farmland would be minimized pursuant to the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and the land unsuitability criteria (see Table 3-1 and Section 5.4.8).

Section 515 (b)(7) of SMCRA requires that stringent topsoil management techniques be employed on all prime farmland, as identified by the Secretary of Agriculture, that is disturbed by surface mining. In short, all fertile topsoils located on prime farmlands would be maintained for re-use during reclamation so that original productivity can be restored. This protection is supported by the lands-unsuitable-for-use criteria which designates identified prime farmland as unsuitable for coal mining unless proven to be reclaimable to the point of producing crop yields equivalent to surrounding non-mined prime farmlands. Mining may also be permitted if it is determined that the lands possess adverse conditions which cause their prime farmland designation to be reversed pursuant to the permanent regulations of the Office of Surface Mining Reclamation and Enforcement for implementation of this section of SMCRA.

5.2.4.4 Fiscal Impacts. Coal-induced population shifts would change the level of demand for public services provided by states and local governments. The services required would include education, health care, welfare services, police

TABLE 5-55

**AGRICULTURAL PRODUCTIVITY VALUES,
COMPARISON OF ALTERNATIVES^a
(thousands of 1974 dollars)**

REGION	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1985 PROJECTIONS											
Northern Appalachian	5170	5073	5238	1	-1	-12	-141	-142	-151	-2	-146
Central Appalachian	1012	1086	1014	0	-7	-16	-3	-5	-43	-9	-13
Southern Appalachian	1249	1712	1787	0	-35	-6	-28	-24	48	-90	-54
Eastern Interior	20806	20997	20630	0	108	-199	-42	1	-161	-511	87
Western Interior	5389	6648	6822	-3	-272	450	-351	-304	-398	2	978
Texas	1652	2289	2186	2	25	-179	-17	-3	-130	-55	150
Powder River	19	23	30	0	0	2	0	0	2	0	-2
Green River-Hams Fork	35	58	71	0	3	17	1	1	21	21	-10
Fort Union	221	265	473	-19	20	3	20	20	47	-30	50
San Juan River	1	2	3	0	0	0	0	0	0	0	0
Uinta-Southwestern Utah	4	4	5	0	0	0	0	0	0	0	0
Denver-Raton Mesa	171	228	279	0	10	5	8	9	35	55	14
1990 PROJECTIONS											
Northern Appalachian	2397	2758	4000	35	4	57	-1	0	-5	11	17
Central Appalachian	536	642	727	0	-6	-6	7	-1	-3	-8	7
Southern Appalachian	599	913	1170	0	-3	69	8	1	15	-31	-43
Eastern Interior	10482	11336	12598	0	-141	2	-116	-85	-150	-344	439
Western Interior	2717	5249	6265	-1	-134	-471	-201	-128	-88	-145	-162
Texas	1039	2109	2350	-6	-127	-193	-38	8	-255	-161	-54
Powder River	12	18	18	0	4	12	2	0	6	4	-2
Green River-Hams Fork	26	35	40	1	6	17	0	1	14	14	-1
Fort Union	162	269	356	0	-16	22	-3	3	14	-69	11
San Juan River	1	2	3	0	0	0	0	0	0	0	0
Uinta-Southwestern Utah	2	2	3	0	0	0	0	0	0	0	0
Denver-Raton Mesa	134	177	204	0	0	19	-3	-3	11	1	-10

^a Agricultural productivity values were calculated by multiplying the percent of total Land Disturbed (Section 5.2.2.1) devoted to cropland times an average value of all agricultural products sold per acre of land (Appendix H, Section H-6). Positive numbers represent greater productivity loss compared to the No New Leasing Alternative.

REGIONAL IMPACTS

protection, fire protection, the provision of water and sewage systems, recreational facilities, libraries, and highways. The fiscal impacts of the change in demand would be a function of the change in the size of the population and of the level and types of services currently provided. Capital expenditures to provide the needed social service facilities as well as the funds to operate and maintain these facilities would also be required.

No estimates of the magnitude of the capital expenditures required are made in this statement since capital costs are a function of community-specific characteristics. For example, a community may have under-utilized school facilities and a part of the increase in the student population may be absorbed, thus reducing the per capita capital expenditure required. Similarly, a public water system may require modification for which the capital expenditure is not proportional to the increase in population. On the other hand, current per capita annual expenditures are a measure of services provided and it is assumed that the level of service they represent would continue.

Estimates of additional "net" annual expenditures that would be required in 1985 and 1990 of the state and local government agencies in each state have been prepared. These estimates have been prepared on a "worst case" basis in the sense that it has been assumed that all coal-induced population shifts would represent interstate migration. To the extent that population shifts are intrastate movements of people from one location to another or from agriculture or another industry to a coal-associated industry, the estimates represent an overstatement of additional State level expenditures. The estimates represent the net effect in terms of government revenues generated from sources within the state and expenditures required. State population changes would increase expenditures but would also increase revenues from individual income taxes, sales taxes, property taxes, and various excise taxes, etc. The estimates of net additional expenditures and of the proportionate impact on total expenditures for coal producing states are presented in Tables 5-56 and 5-57. These data represent ranges based on the population shifts projected for the low and the high coal production projections for the no new leasing and preferred program alternatives. These options bound the upper and lower limits of all other alternatives addressed in this environmental impact statement.

Table 5-58 presents estimates for 1985 and 1990 of the changes which would occur in state and local government expenditures in non-coal producing regions. The magnitude of these changes is relatively small, representing no more than one percent of total expenditures and, therefore, have not been offset against changes in revenue.

The difference between state and local expenditures and internally generated income represents that portion of revenue received from the Federal Government through revenue-sharing and Federal-aid programs, such as Federal aid for highways or urban renewal funds. The total of the net changes—in the range of \$153 to \$445 million under the no new leasing alternative and of \$146 to \$655 million under the preferred program—represents the national increase in revenue sharing and Federal aid associated with the coal-related population. It does not represent an absolute increase in these revenues as it has been assumed that Federal policies in these areas would not change. The state-by-state net

changes shown in Tables 5-56 and 5-57 may be construed as shifts in revenue sharing and Federal aid funding. However, due to the nature of the specific Federal programs, such changes might not be wholly realized. Therefore, the more severely impacted states such as Wyoming and Montana could seek to raise revenue by other means, for example, through the imposition of an increased coal severance tax.

5.2.4.5 Tax Lead Time. The ability of a region to absorb the impacts on the demand for public facilities and services from interregional population shifts depends on the size of the existing infrastructure and the magnitude of the impacts. Regardless of the Federal coal management program alternative finally selected, many areas in the western coal producing states would experience substantial increases in coal-related activities with concomitant significant increases in population. As a result, state and local governments having jurisdiction in these areas would experience significant fiscal impacts where existing public facilities and services systems are either currently deficient or are already at capacity. In other words, large highly developed infrastructures would be better able to absorb a given level of development than small underdeveloped infrastructures.

Overall estimates of fiscal impacts on a state-by-state basis are presented in Section 5.2.4.4 above. These estimates pertain to impacts on public services. The extent to which an individual community is impacted is site-specific. The acquisition of funds to expand public service systems in order to meet coal-induced population increases is a major problem facing many communities. This problem is the result of

- Time lags between the identification of specific public service needs and the operation of facilities to meet those needs, i.e., the time required to plan, design, and construct facilities; and
- Time lags between the need to fund the development of the infrastructure and the generation of tax revenues from the additional population served.

Although prospective revenues (from royalties or severance taxes) resulting from the Federal coal management program may be more than adequate to cover that portion of the costs of local government operations not met through regular tax revenue services, and to cover the additional debt service and capital repayments for infrastructure development, they are not likely to be available when needed. This deficiency can be met in a number of ways.

If revenues generated by energy development are sufficient over the long run to meet the costs of expanding public facilities and services, loans provide a logical front-end funding mechanism. Alternatives under this category include;

- Loans through the Federal government—either in the form of a direct loan program or a guaranteed loan program; and
- Prepayment of taxes (severance, property, income, sales, or use taxes) or royalties by coal producers over a period, for example, of 2 or 3 years before the intensive coal production activity begins. These prepayments would, in effect, be short-term, no interest loans by industry to the local or state governments.

Another revenue source involves direct financing assistance. This funding source presumes either that energy

TABLE 5-56

NET IMPACT ON STATE AND LOCAL GOVERNMENT
EXPENDITURES IN COAL PRODUCING STATES
NO NEW LEASING ALTERNATIVE
1985 AND 1990
(In 1975 Dollars)

STATE	1985		1990	
	AMOUNT (million \$)	PERCENT IMPACT	AMOUNT (million \$)	PERCENT IMPACT
Alabama	2-17	*-1	4-18	*-1
Arizona	3-5	*	4	*
Arkansas	6-11	*-1	6-34	*-2
Colorado	5-10	*	10-12	*
Georgia	5-8	*	4-14	*
Idaho	2-3	*	3	*
Illinois	24-18	*	47-50	*
Indiana	2	*	3	*
Iowa	2-3	*	3-4	*
Kansas	1	*	*-1	*
Kentucky	3-5	*	5-14	*
Louisiana	*	*	*	*
Maryland	2-5	*	4-5	*
Missouri	1-2	*	2	*
Montana	8-14	1-2	12-24	2-3
Nebraska	5-8	*	7-10	*-1
New Mexico	1-6	*-1	3-13	*-1
North Dakota	1-5	*-1	3-8	*-1
Ohio	3	*	*-6	*
Oklahoma	(*)-1	*	(*)-3	*
Pennsylvania	27-29	*	25-28	*
South Dakota	1-3	*	2-7	*-1
Tennessee	(2)	*	2-12	*
Texas	17-24	*	26-38	*-1
Utah	6-17	1	10-23	1-2
Virginia	5-2	*	(1)-1	*
West Virginia	7-1	*	4-22	*-1
Wyoming	21-52	4-10	33-66	6-13

*Value is less than 0.5.

() Decrease in net expenditures.

Sources: Derived from projections of coal-induced population shifts
(section 5.2.4.1) and from Reference Number 86.

TABLE 5- 57

NET IMPACT ON STATE AND LOCAL GOVERNMENT EXPENDITURES IN
COAL PRODUCING STATES PREFERRED PROGRAM
1985 AND 1990
(In 1975 Dollars)

STATE	1985		1990	
	AMOUNT (million \$)	PERCENT IMPACT	AMOUNT (million \$)	PERCENT IMPACT
Alabama	2-16	*-1	4-26	*-1
Arizona	3-5	*	4-13	*-1
Arkansas	6-11	*-1	6-19	*-1
Colorado	5-11	*	16-33	1
Georgia	5-8	*	4-22	*
Idaho	2-3	*	3	*
Illinois	24-16	*	47-71	*-1
Indiana	2	*	3-4	*
Iowa	*-1	*	1	*
Kansas	1	*	*-2	*
Kentucky	3-4	*	5-7	*
Louisiana	*	*	*-1	*
Maryland	2-5	*	6-7	*
Missouri	1-2	*	2-3	*
Montana	8-3	1-*	13-64	2-8
Nebraska	5-8	*	7-16	*-1
New Mexico	1-6	*-1	3-17	*-1
North Dakota	1-5	*-1	3-8	*-1
Ohio	3	*	3-32	*
Oklahoma	(*)-1	*	(*)-3	*
Pennsylvania	27-29	*	25-49	*
South Dakota	1-3	*	2-6	*-1
Tennessee	(2)-(1)	*	2-5	*
Texas	17-23	*	25-65	*-1
Utah	6-17	1	10-26	1-2
Virginia	(5)-(2)	*	(1)-26	(*)-1
West Virginia	7-1	*	4-36	*-2
Wyoming	21-58	4-11	46-92	9-18

*Value is less than 0.5.

() Decrease in net expenditures.

Sources: Derived from projections of coal-induced population shifts-
(section 5.2.4.1) and from Reference Number 86.

TABLE 5-58

IMPACT ON STATE AND LOCAL GOVERNMENT
EXPENDITURES IN NON-COAL PRODUCING STATES
BY CONSUMING REGION
1985 and 1990
(in 1975 Dollars)

STATE	ALTERNATIVE			
	NO NEW LEASING		PREFERRED PROGRAM	
	<u>1985</u>	<u>1990</u>	<u>1985</u>	<u>1990</u>
	(Million Dollars)			
California	5-12	6-22	5-12	6-61
Connecticut, Massachusetts, and Rhode Island	6-8	6-15	6-8	6-46
Delaware & New Jersey	(*)-1	(*)-1	(*)-1	(*)-9
Florida	2-5	13-49	2-5	13-62
Maine, New Hampshire and Vermont	1	1-2	1	1-6
Michigan	10-18	19-39	10-19	20-92
Minnesota/Wisconsin	12-27	22-9	10-28	22-62
Mississippi	1	1	1	1-3
Nevada	(6)	(6)	(6)	(6)-(5)
New York	10-13	9-83	10-13	9-30
North & South Carolina	5-9	4-(14)	5-9	4-25
Oregon & Washington	1-*	1-40	1	14-6

* Less than \$0.5 million

() Decrease in expenditures.

Sources: Derived from projections of coal-induced population shifts
(section 5.2.4.1) and from Reference Number 86.

development would not normally provide sufficient long-term revenues to pay for needed community facilities, or that impacted communities should not have to pay, even if they can afford to over the long-term. Alternatives under this category include the following:

- Direct financial assistance from the Federal Government could be provided through new or existing programs. There are a number of existing Federal grant program of this type.
- Energy developers could directly finance needed community facilities, voluntarily or as a condition for approval of state permit applications. Such financing could be provided under lease-purchase or lease-with-option-to-purchase agreements, under which the energy developer finances construction and the local jurisdiction leases the facilities with an option to purchase.

Various uncertainties plague energy developments. Stable and continued operation of mines and associated facilities can be threatened by contingencies over which neither the industry nor state government has control. Plant production could be cut-back or halted during the operation phase causing layoffs, outmigration, and loss of local and state government revenues. Second, even after major project permits are issued, legal, political, or financial contingencies may make it difficult or impossible to say exactly when or whether plant production (and revenue generation) would be achieved.

Assuming that the anticipated development of coal results in a stable and continuing situation, state and local governments will receive revenues through taxes from the increase in population and through severance taxes or royalties. Revenue from the latter source could be used for debt repayment. Severance taxes, however, are not imposed by every coal-producing state (for example, Utah) and where it exists, the rate varies. Table 5-59 presents the current levels of severance taxes. These taxes apply to coal extracted from non-Federal land. The comparable source of revenue from coal extracted from Federal land is coal royalties. In August 1976, an amendment to the Federal Coal Leasing Amendments Act and the Federal Land Policy and Management Act increased the state share of lease and royalty payments for minerals extracted from Federal lands from 37.5 percent to 50 percent, and relaxed restrictions on the use of these revenues, providing that they be used as the state legislature directs, giving priority to energy impacted communities.

Table 5-60 presents estimates of potential levels of royalties and severance taxes that might accrue to the various states under the Federal coal management program. The precise mix of Federal and non-Federal coal production for each of the western states is not known. However, the range of funds flowing to the states is calculated assuming 100 percent production on Federal lands (for royalty payments) and 100 percent on non-Federal lands (for severance tax payments). In this manner, the range of severance tax and royalty funds is effectively bracketed.

Mitigation of future tax lead time impacts can only be achieved through implementation of planning programs prior to energy resource development. Because of the general nature of the tax lead time problem, a concerted state and Federal approach with private participation would be required.

5.2.4.6 Coal Cycle Fatalities. Fatalities can occur in all phases of the coal cycle. They are caused by human error, structural and mechanical failures, and natural phenomena. This discussion is limited to those fatalities associated with coal mining beneficiation and conversion.

A number of observations are useful to place the discussion that follows in a proper perspective.

- Coal mining is a high-risk occupation. This is especially true for underground mining and, to a lesser degree, for surface mining [61].
- Due to these risks, increased coal production whether by underground, surface, or some combination of the two mining methods would result in increased levels of fatalities regardless of which Federal coal management program alternative is adopted.

Estimates of the fatalities associated with the no new leasing and preferred program alternatives, mid-level coal production, are presented in Table 5-61. The increases for the three regional groupings in this table are a function of the level of coal production and the method of mining. Thus, the proportionately larger production effort in the western regions results in a significant fatality increase in 1985 despite the predominant use of the lower-risk surface mining technique. The fatality increase in the midwestern regions is not as great as in the western regions because production is less. However, the fact that about half the coal produced is by underground mining tends to keep the fatality level high.

In the Appalachian Coal Regions, the increase in fatalities in 1985 over 1976 can be attributed primarily to a shift to underground mining methods (higher risks) with only a slight increase in production.

With regard to the 1990 figures, analysis is much more difficult. Although total coal production is projected to increase by about 28 percent over 1985 levels, the fatality level increases by over 60 percent. On a national basis, the same mix of mining methods is used in both years i.e., about 27 percent more coal is mined by surface methods than underground. The Appalachian Coal Regions show little differences between the two alternatives, while the midwestern coal and western coal regions indicate a noticeable shift in fatality levels. Since the no new leasing alternative compared to the preferred program results in a greater emphasis on eastern production over western production, and increases in eastern production would be due to a greater dependence on underground mining than surface mining, it is probable that the fatality levels between eastern and western regions would differ accordingly for the alternatives. For the no new leasing alternative, a greater fatality level is forecast in the midwest where the increase in production is to occur (more underground mining) whereas the preferred program, which results in greater western production (more surface mining) forecasts just the opposite.

Data for the other five program alternatives considered are not shown. The significant variations in the levels of projected fatalities for 1985 were estimated compared to the no new leasing alternative. In 1990, under the meet industry needs alternative, one significant shift in fatalities was estimated, i.e., a decrease of 16 fatalities in the Eastern Interior Coal Region was balanced by an increase of 16 fatalities in the Powder River Coal Region. The probable explanation for this forecast was addressed above in terms of

TABLE 5-59

SEVERANCE TAXES - WESTERN COAL PRODUCING STATES

STATE	SEVERANCE TAX
Colorado	60¢ per ton on surface-mined coal 30¢ per ton on underground-mined coal
Montana	30 percent of gross value of coal produced
New Mexico	38¢ per ton (steam coal) 18¢ per ton (metallurgical coal)
North Dakota	65¢ per short-ton (current rate); to rise 1¢ per ton for each one- point increase in Wholesale Price Index using 1977 as the base year
Utah	No severance tax. Several taxes have been proposed; none have passed. The State now finances coal development impacts from Federal leasing royalties
Wyoming	10.5 percent of gross value of coal produced

Source: Reference Number 87,

TABLE 5-60

PROJECTED 1985 AND 1990 COAL ROYALTIES
AND SEVERANCE TAXES ^(a)
(million dollars)

STATE	1985		1990	
	PROJECTED ^(b) ROYALTIES	PROJECTED SEVERANCE TAX REVENUES	PROJECTED ^(b) ROYALTIES	PROJECTED SEVERANCE TAX REVENUES
Colorado	31.4	12.5	49.9	16.3
Montana	148.6	393	259.1	664
New Mexico	30.9	8.4	64.2	21
North Dakota	36.9	19.2	49.4	31.5
Utah	31.4	None ^(c)	36.4	None ^(c)
Wyoming	229.4	425	366	577

(a) Projected on the basis of the medium production of the medium production level under the preferred coal management program alternative, assuming a value of \$20 per ton at the mine.

(b) Represents the one-half share of Federal coal royalties occurring in affected states.

(c) Utah has no severance tax on coal production (as of October 1978).

TABLE 5-61

COMPARISON OF FATALITIES FROM COAL MINING, BENEFICIATION,
AND CONVERSION UNDER THE NO NEW LEASING AND PREFERRED
PROGRAM ALTERNATIVES (MEDIUM PRODUCTION LEVEL)

REGIONAL GROUPINGS	1976 BASELINE	1985		1990	
		NO NEW LEASING	PREFERRED PROGRAM	NO NEW LEASING	PREFERRED PROGRAM
APPALACHIAN REGIONS (Northern, Central, Southern Regions)	113	143	142	192	183
MIDWESTERN REGIONS (Eastern Interior, Western Interior, Texas)	36	77	78	162	120
WESTERN REGIONS (Powder River, Fort Union Green River - Hams Fork Denver - Raton Mesa, Uinta - Southwestern UT San Juan River)	<u>18</u>	<u>61</u>	<u>58</u>	<u>104</u>	<u>141</u>
TOTAL	167	281	278	458	444

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coal production shifts to the West which tends to increase fatalities there, and a de-emphasis of underground mining in the Midwest.

5.2.4.7 Cultural Resources. Discussed in this section are the impacts to be expected from each of the program alternatives on archaeological and historical resources.

Archaeological Resources. It is not possible, at present, to estimate the extent of potential archaeological resource impacts due to various levels of coal development. Present levels of archaeological site information are based, primarily, on localized general surveys or on surveys performed prior to specific construction projects (e.g., mines, highways, or power plants). The concept of archaeological site density for a particular region cannot be used to determine potential impacts except in a very general sense, since they are dependent on the exact location of a particular leasehold and of the activities associated with coal development in the leasehold.

Coal development activities, particularly those related to surface mining, produce surface disturbances which may affect archaeological resources. In general, archaeological sites might be affected by the disturbance of artifacts or other evidence of a surface site, by grading or excavation that destroys a subsurface site, by destruction of site integrity through alteration of the adjacent landscape setting, or by the exposure of a site to vandalism and unauthorized artifact collecting. It is not only the comparatively massive excavations associated with surface mining that could adversely affect an archaeological site but even lesser activities such as vehicle parking and open storage of materials. Vehicle movement in an ungraded, unsurfaced parking area could easily disturb surface evidence or destroy a surface site. Similarly, the excavation and reclamation of a 6,000-acre surface mine may not encounter and thus not disturb any archaeological sites while a cut for a short section of 40-foot wide, employee-access road leading to this mine could completely destroy a site. A site-specific survey is absolutely necessary to determine any potential archaeological impacts due to coal development. Because of this variability of potential impacts, there is no direct correlation between interregional or intraregional coal production levels and the extent of potential archaeological site impacts.

A 1976 amendment to the National Historic Preservation Act of 1966 (16 U.S.C. 470) now requires that a Federal agency take into account the potential impact of an undertaking not only on sites included in the National Register but also on sites eligible for inclusion in the Register, and an executive order of 1971 (E.O. 11593, 16 U.S.C. 470) directs Federal agencies to locate, inventory, and nominate to the National Register properties under their jurisdiction or control. The National Register criterion used in determining the eligibility of archaeological sites is any site that has yielded or may be likely to yield information important in prehistory or history (36 CFR 800.10). The Department of the Interior together with the Advisory Council on Historic Preservation will take appropriate steps (site surveys, evaluations, eligibility determination, impact analysis, etc.) to minimize potential archaeological disturbances.

Historical Resources. Although the number of historical sites presently on the National Register is far greater than the

number of archaeological sites, there is still a need to protect important historical sites, particularly certain types of sites in the western areas. Historical sites and certain architectural styles are not as well represented in the West as in the East, with ranches and windmills particularly needing added representation [56].

Any community changes that occur because of coal development could affect the older, historic core of existing communities. Representative architectural styles as well as buildings of local historical significance could be lost to make room for new structures. The historical integrity of a group of structures could similarly be affected by new construction. Although it can be postulated that some adverse impacts to historical resources would occur, it is not possible to estimate the extent or magnitude of such potential impacts at the programmatic environmental impact statement level. However, as is the case with archaeological resources, the Department of the Interior, together with the Advisory Council on Historic Preservation, will take appropriate steps to minimize potential historic site disturbances.

5.2.4.8 Recreational Impacts. The greatest impact on recreation facilities would be the increase in the recreation demand caused by population increases. In addition, the areas being mined would be unavailable for any potential recreation activities until after reclamation activities have been completed. Overcrowding and overuse of existing facilities, a decrease in the quality of recreation activities requiring facilities or solitude, increased administrative costs, and increased vandalism could result [57]. The increased demand for recreation facilities would also cause more conflicts between private land owners and people desiring to use land for recreation. The increased number of people going to the country for hiking, camping, and other outdoor experiences could reduce the quality of wilderness type recreation on large areas of public lands, particularly in the western regions.

While the Surface Mining Control and Reclamation Act of 1977 (Section 522(e)) prohibits new surface mining on certain types of recreational land systems, or within 300 feet of any public park, these areas could still be adversely affected by nearby mining operations.

Wildlife for hunting and viewing could be reduced by increased urbanization. The increased hunting pressure could necessitate reductions in hunting seasons and bag limits. Demand already exceeds supply for deer and elk hunting permits in parts of western Colorado, reducing hunting opportunities in that portion of the Uinta-Southwestern Utah Coal Region [58]. Increased fishing pressure could also reduce the present capabilities of many areas to attract and sustain recreational fishing.

Workers brought into expanding coal development areas would tend to be younger and desire more recreational opportunities than the permanent residents. If long-term recreation facilities were built for the peak coal-related population, these facilities could become a tax burden when the peak levels out.

Expansion of coal mining could also have some beneficial impacts on recreation. Part of the greater tax revenue generated by the increased activities and population could be used to help alleviate pressure on existing municipal facilities. Mining operations could open up new roads and trails to off-

road-vehicle use¹ [59]. Recontouring and replanting of land during reclamation could sometimes increase habitat for small game, waterfowl, and migratory birds.

A detailed determination of the extent of potential coal development-related recreation impacts is highly dependent upon a variety of regional and sub-regional specific recreation data. These data from the regional, county, and municipality level include the present use levels of all area recreation facilities and an analysis of these use levels in terms of capacity. This would provide the basis for determining which facilities have excess capacity, which are at capacity, and which are overused. The recreation characteristics of projected population increases would be needed to indicate what types of facilities or activities would be the focus of additional recreation pressures. The location of new mines would have to be known before the data required for such a recreation impact determination could be meaningfully collected. There cannot be at this time, therefore any substantive determination of how potential management program alternatives differ in this respect, except to the extent that the alternatives emphasize development of western region coal reserves particularly in the Powder River and Green River-Hams Fork Coal Regions. Accordingly, the lease to meet industry needs alternative would create the greatest stress on resident population lifestyles while the no new leasing alternative would reduce the stress. The determining factors are the potential changes in the coal-related population (see section 5.2.4.1).

5.2.5 Transportation System Impacts

This section identifies and discusses the major impacts on the national transportation system due to the increase in coal production anticipated in the near-term (by 1985). For the purpose of quantifying some of these impacts, the medium level coal production projection has been used, i.e., 1.1 billion tons in 1985 and 1.5 million tons in 1990. Production levels of this magnitude are substantially higher than the current (1976) production level of 674 million tons [59a]. Coal transportation requirements would, proportionately, increase even more as "coal from the West, where most U.S. reserves are located, will become more important . . . the transportation system will be required to accommodate both a substantial general step-up in the quantity produced and a dramatically sharp increase in western production, with the attendant longer hauls required" [60]. However, the proportionately greater increase in transportation requirements would be mitigated to some degree through an increase in intrastate movements due to the shifts in population into coal producing areas and to whatever extent the trend in minemouth consumption (about 12 percent in 1976) continues. Interregional coal flows are depicted in Figures 5-3 through 5-5.

In terms of the modes of transportation used for coal movements, the railroad industry would have to assume the predominant burden of increased transportation including the following responsibilities.

- The pattern of coal flows could substantially differ from the current pattern which emphasizes flows from the western coal producing regions eastward.
- Western coalfields would be for the most part, inaccessible to water transportation although

intermodal movements via the Great Lakes and the Mississippi River system could increase.

- Truck transportation would be generally limited to short-haul movements generally intrastate movements of 50 to 75 miles [61].
- Slurry pipelines would increase in significance as a coal transportation mode provided certain issues were resolved. (However, as a transportation mode, they have limited application in the near-term. Total thruput capacity of all pipelines, operational or in the development stage, would be limited to 100-150 million tons per year).

In terms of net ton-miles of transportation service, the modal split, across all states, used in this analysis is as follows:

- Rail - 77 percent
- Pipeline — 13 percent
- Waterway — 9 percent
- Trucks — 1 percent This section, therefore, focuses on the railroad industry and treats the other modes more briefly.

5.2.5.1 Railroads. As noted above, coal transportation by rail would increase as a function of both increased tonnage to be moved and the greater distances involved. Impacts of an institutional nature may be categorized in terms of:

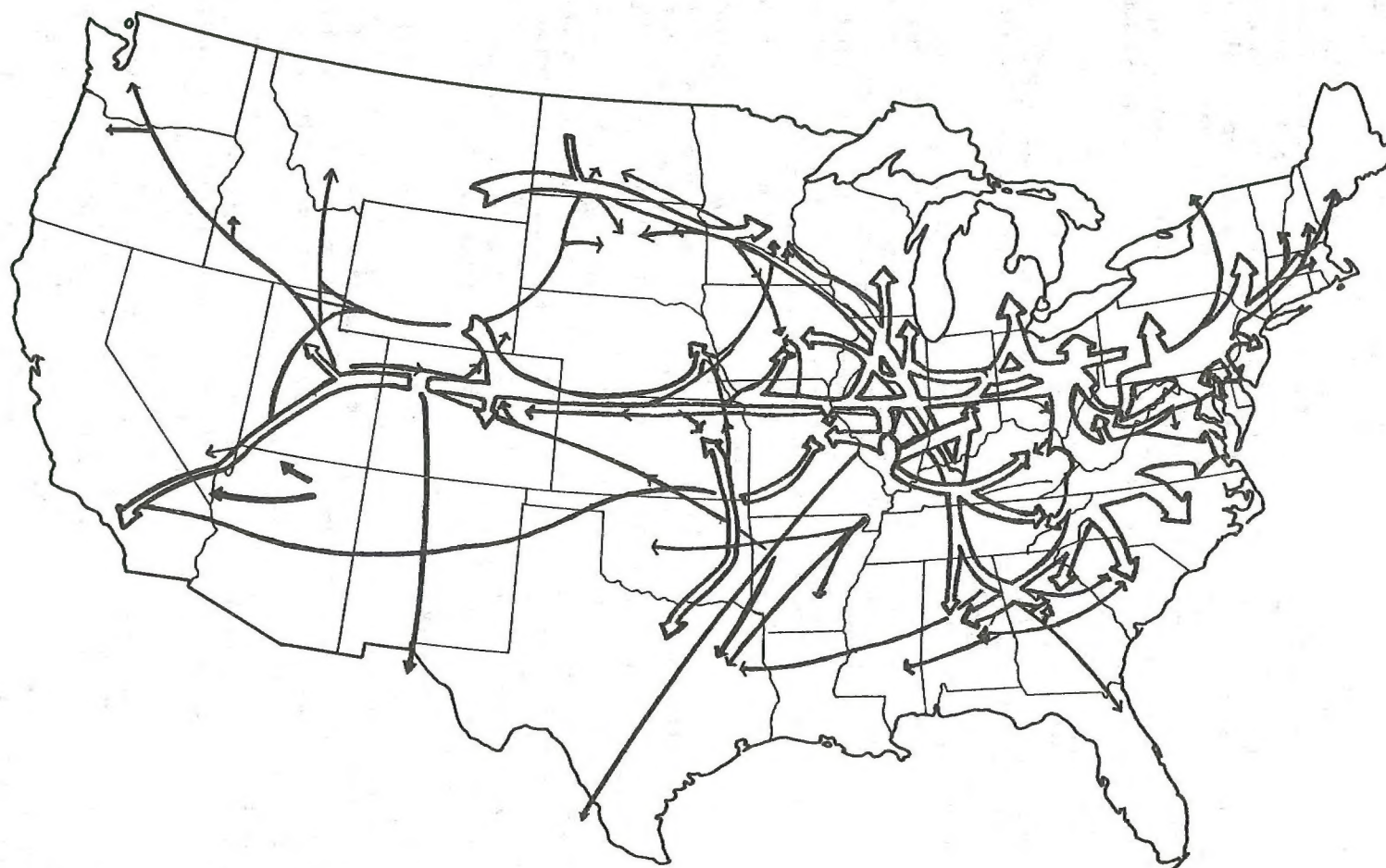
- The physical capacity of the railroad system. This includes rights-of-way, railroad plant, and railroad equipment (freight cars and locomotives).
- The financial capability of the industry to secure the investments required to expand its physical capacity.

In addition, there are a number of operational impacts to be considered; the more significant of these includes air emissions, operating energy requirements, fatalities, and transportation interface problems such as transferring coal from rail to barge or truck.

For the purpose of considering institutional impacts on a "worst case" basis, it has been assumed that all interstate coal tonnage would be moved by rail and that 75 percent of the intrastate tonnage would move by rail, i.e., a total of 1,044 million tons of coal in 1985 and 1,456 million tons in 1990. Institutional impacts are considered in the context of the total industry needs to move all freight, not just coal.

System Capacity. The capacity of a transportation system is a complex concept involving both rights-of-way and transportation plant and equipment, definable in the sense that capacity is reached when the volume to be transported cannot be delivered without undue delay due to traffic congestion. In this sense, capacity is a function of the type and condition of the right-of-way available, equipment availability, and operating conditions. Plant only affects capacity indirectly in terms of equipment availability (i.e., down time during car repairs) and operating conditions, and is not considered further with respect to the railroad industry.

In terms of rights-of-way, there are no comprehensive estimates of the railroad industry's capacity [62]. It is a function of line mileage, the number of tracks per line, the length and spacing of sidings (to permit the passing of trains on the same single-track line), the type of signalling system and train control, traffic imbalance, and peaking patterns, and track conditions [63]. One matter of concern is the condition of the track, as this dictates the type of equipment and the



Source: U. S. Department of the Interior, 1977.
Total Coal Movement, Map No. 5, National
Energy Transportation Systems. U.S.
Geological Survey. Reston, VA.

NOTE: This line thickness
approximates
40 million short
tons carried per
year.



FIGURE 5-3

1974 MAJOR INTERSTATE COAL FLOWS BY RAILROAD

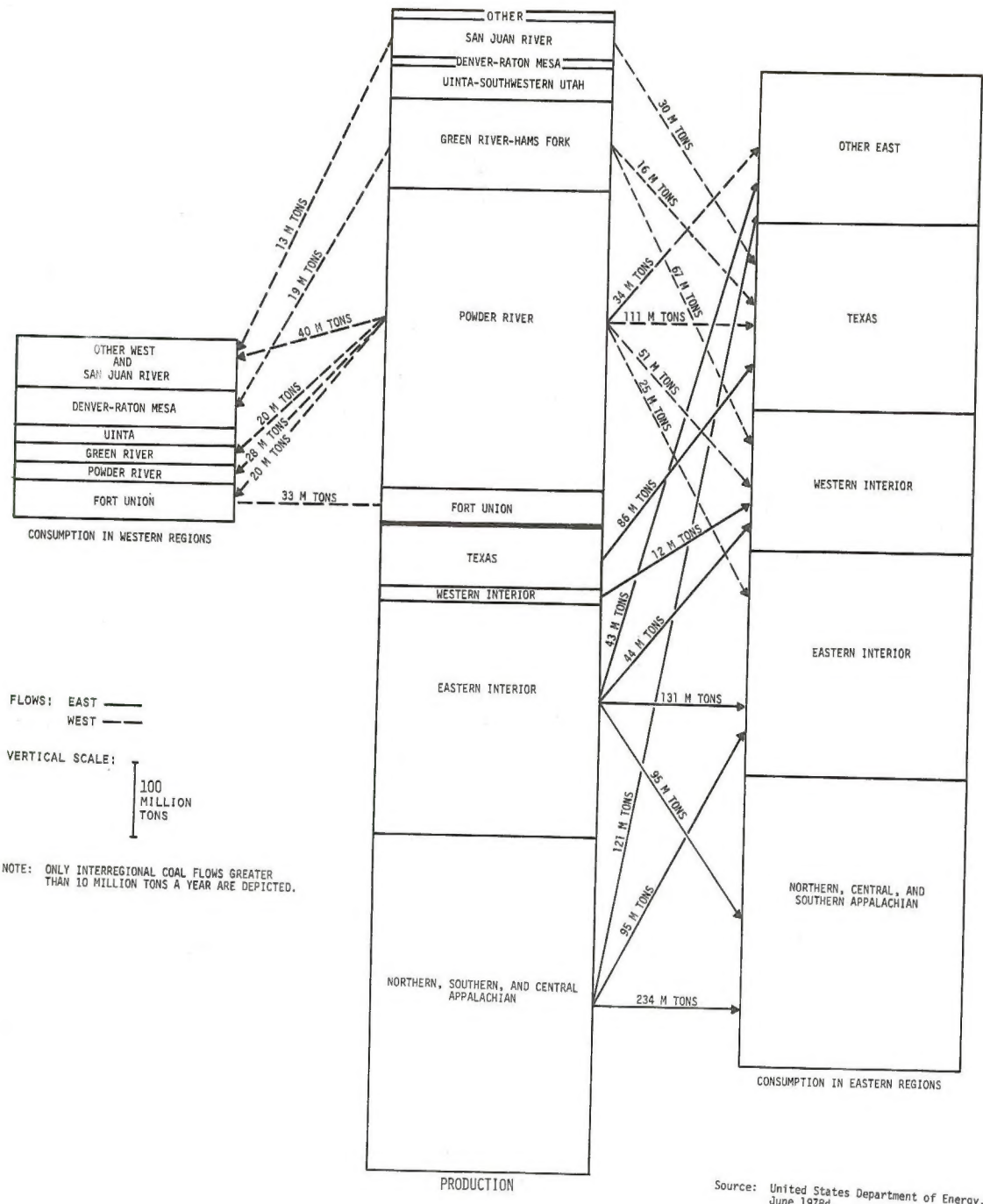


FIGURE 5-5
REGIONAL COAL PRODUCTION AND CONSUMPTION FLOWS - 1990
MILLIONS OF TONS (M)

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loads that could be hauled, and influences capacity in terms of train speed. Therefore, it is recognized that many rights-of-way would have to be upgraded to accommodate increased coal traffic [60]. Rails would need upgrading to a level at which they could endure the heavier weight of coal trains—not merely by laying heavier rail sections but by concentrating on drainage, ballast, and ties [64].

Other means of increasing capacity, and thus eliminating potential bottlenecks, are available. These means include:

- Double tracking of existing single track line,
- Alternating single- and double-track,
- Increasing the length and frequency of passing sidings, and
- Upgrading traffic control systems to automatic block signals or even to Centralized Traffic Control (CTC).

Among these means, double tracking with CTC would have the greatest effect on line capacity—raising it to 125 trains per day [65]. Such measures could increase the railroad's capacity to handle increased coal and other traffic, and, in fact, extensive plans for improving rights-of-way have been formulated by the railroads concerned, e.g., Burlington Northern, Seaboard Coast Line. It has been stated that all required rights-of-way to transport the increased coal traffic projected for 1985 are in place and that plans exist to construct at least a further 300 miles of rail line to meet coal needs [60]. This construction is estimated to cost \$300 million.

Other estimates include 1,000 miles of new construction contemplated in the western coal regions. One estimate includes: 1) the completion of the line connecting Gillette and Douglas, Wyoming; 2) an extension of the existing Burlington Northern (BN) Decker spur northwest to the Colstrip, Montana, spur and north along the Tongue River to the BN mainline at Miles City, Montana; 3) completion of the BN Gillette north spur; 4) two extensions of the Sante Fe Railroad mainline north to the Star Lake, and the Four Corners, New Mexico, area; and 5) an extension of the Union Pacific Railroad mainline to Kaiparowitz Plateau [67].

Potential transportation impacts would be a regional issue due to the shift in the pattern of coal flows. Only 23,000 miles of railroad lines (11 percent of the national totals (derived from Reference 66) lie within the borders of seven western states (Arizona, Colorado, New Mexico, Montana, North Dakota, Utah, Wyoming) in which over half the recoverable coal reserves are located; only 6,900 miles of railroad lines (3 percent) are in Montana and Wyoming which contain the Powder River Coal Region (37 percent of recoverable reserves) as well as portions of the Green River-Hams Fork Coal Region.

The capacity of the existing system to accommodate the coal flows projected in this statement, these flows were analyzed on a state-by-state basis and compared to the capacities of the transportation system links over which they would move. This analysis took into account the increase in non-coal traffic projected at a compound annual growth rate of one percent. Based on assumed link capacities of 25 trains per day for single-track lines and 70 trains per day for double-track lines, it was determined that capacity would be exceeded in 1985 on 5 of the 215 coal routes examined. The sections of the rail network that may become overloaded are presented in Table 5-62. Expected capacity shortfall has been characterized as:

- Moderate — not more than 100 percent of capacity
- Severe — over 100 percent of capacity.

Given the above factors, and the expressed willingness of the railroad industry to expand line capacity as evidenced by their current plans impacts on rail capacity (in terms of rights-of-way) of projected increases in coal traffic would be relatively small or could be mitigated through additions to or upgrading the existing network.

Equipment needs to provide transportation service are a function of the ton-miles of freight movements and the speed with which these movements are completed, i.e., trip turnaround time. In 1976, revenue freight movements of all Class I railroads were approximately 791 billion ton-miles [66]. Coal traffic is estimated to account for 15 percent of this total or about 110 billion ton-miles based on historical data (References 60 and 68).

Based on the projected coal movements by rail referred to above, movements of freight other than coal projected at an annual compound growth rate of one percent, and average haul distances presented below, freight transportation service estimates have been developed. The average haul distances used are as follows:

- Interstate movements of coal — 700 miles (based on the medium production projection for the lease to meet DOE production goals alternative).
- Intrastate movements of coal — 75 miles.
- Movements of other freight — 700 miles (derived from Reference 66).

Estimated freight transportation services would be as follows:

- Interstate coal movements — 574 billion ton-miles in 1985 and 854 billion ton-miles in 1990.
- Intrastate coal movements — 17 billion ton-miles in 1985 and 18 billion ton-miles in 1990.
- Noncoal movements — 738 billion ton-miles in 1985 and 775 billion ton-miles in 1990.
- Total movements — 1,329 billion ton-miles in 1985 and 1,647 billion ton-miles in 1990.

Freight transportation services of this order of magnitude would be substantially higher than the current level. Equipment requirements — hopper and other freight cars and locomotives — have been estimated for both coal and noncoal movements. The latter were examined in terms of hopper cars and other freight cars separately, as it has been assumed that all hopper car movements would be in unit trains. Freight car requirements are expressed in 100-ton car equivalents and have been estimated using assumptions with respect to the number of car trips per year, thus subsuming distance, average speed, and turnaround requirements.

Annual freight car trip assumptions are listed below:

- Interstate coal movements — 40 trips per year.
- Intrastate coal movements — 50 trips per year.
- Noncoal hopper car movements — 40 trips per year.
- Nonhopper car movements — 10 trips per year.

Estimated freight car requirements are presented in Table 5-63.

These estimates may be compared to the current (1976) freight car fleet of Class I railroads — 360,000 hopper cars and 1,330,000 other types of freight cars [66]. The current hopper car fleet (average car size - 80 tons) is sufficient in number but insufficient in carrying capacity to accommodate the increase

TABLE 5-62

POTENTIALLY CONSTRAINED RAIL LINKS

<u>State</u>	<u>Route</u>	<u>Expected Capacity Shortfall</u>	<u>Road</u>
Wyoming	East from Gillette to South Dakota border (Clifton)	Severe	Burlington Northern
Wyoming	North to South through Wyoming from Montana border (Frannie Jct.) to Colorado border (Cheyenne)	Severe	Burlington Northern, Colorado & Southern
Colorado	East from Glenwood Springs to Denver	Moderate	Denver & Rio Grande
South Dakota	North and South from North Dakota border (Aberdeen) to Nebraska border (Jefferson)	Moderate	Chicago, Milwaukee, St. Paul & Pacific
Tennessee	East from Nashville and Knoxville to North Carolina border	Moderate	Southern, L&N

Source: Reference Number 77

TABLE 5-63

FREIGHT CAR REQUIREMENTS

<u>EQUIPMENT</u>	<u>1985</u>	<u>1990</u>
	<u>Number in 100-ton Car Equivalents</u>	
Coal hopper cars	249,800	352,200
Noncoal hopper cars	<u>81,500</u>	<u>85,500</u>
Total hopper cars	311,300	437,700
Other freight cars	<u>728,000</u>	<u>766,000</u>
Total freight cars	1,059,300	1,203,700

Source: Reference Number 66

in coal and other bulk freight assumed to be required by 1985. However, new cars being built are generally of 100-ton capacity and as old cars are retired the fleet carrying capacity would be increased.

Current manufacturing capacity for all types of freight cars is on the order of 80,000 cars per year [69]. Assuming that freight cars are replaced at an annual rate of four percent, the replacement of the freight car fleet other than hopper cars would require a production rate of 53,200 cars per year. Further, assuming that new jumbo hopper cars average 100-tons capacity per car, and that the balance of manufacturing capacity was devoted to the production of hopper cars, there would be a shortage of about 5,000 hopper cars in 1985 in terms of carrying capacity. This shortfall is within the margin of error in the estimates developed. However, within the period 1985 to 1990, an additional 106,400 hopper cars would be required and the equivalent of 72,000 100-ton hopper cars would have to be replaced. Existing manufacturing capacity is insufficient to accommodate this requirement by 44,400 jumbo hopper cars; alternatively, freight car manufacturing capacity would have to expand at a rate of approximately one percent per year through 1990.

To meet increased coal transportation needs, the railroad industry would also have to expand its fleet of locomotives. This fleet has consistently been at a level of 27,000 to 28,000 units during the last decade [66]. Given the above levels of freight car requirements, locomotive requirements have been estimated. Assuming that all interstate hopper car movements would be by unit train operation and would require five locomotives per unit train for a total of 15,000 horsepower [64] and that all other movements would require comparable locomotive power, locomotive requirements would be approximately 27,800 units in 1985 and 33,700 units in 1990, of which 12,500 and 17,600 units respectively would be attributable to the transportation of coal.

Locomotive manufacturing annual capacity is estimated to be a maximum of 1,700 units [69]. Taking into account that the manufacturing industry also produces 200 to 300 units for export annually, a more conservative estimate of 1,500 units capacity available to the domestic market was used. Based on average annual acquisitions of locomotives by Class I railroads over the past decade, i.e., 1,050 per year [66] current manufacturing capacity would be sufficient to meet locomotive requirements through 1985, but insufficient in the period 1985 to 1990. During this period, 4,800 units would have to be replaced and an additional 5,700 units would be needed due to increased coal transportation. To meet this need, manufacturing capacity would have to increase at an annual growth rate of approximately 15 percent to meet the estimated railroad industry demand in this time period.

Financial Capability. The financial capability of the railroad industry should be viewed in terms of the total investment it might be required to make—to provide transportation services both for coal and for other freight—for rolling stock, trackage, and other railroad facilities and in terms of its ability to acquire capital to fund that investment.

Over the past decade (1968 to 1977), gross new capital investment by Class I railroads has averaged \$1.8 billion per year. Of this amount, 75 percent has been invested in equipment (allowing for the value of leased equipment) while

the balance has been invested in roadway and structures [70]. This may be compared with recent estimates of capital requirements for increased coal transportation through 1985. One study [60] indicates that, between 1977 and 1985, \$5 to \$7 billion would be required to purchase and upgrade hopper cars and locomotives and a further \$4 to \$5 billion would be required to upgrade and build new track. In total, this would represent an annual average of up to \$1.5 billion (87.5 percent of the level of investment in the last decade). Elsewhere, it has been stated that between 1978 and 1985, the railroads would have to invest \$6.4 to \$8.8 billion in rolling stock for coal traffic, (840 million tons in 1985) of which \$3.7 to \$6.1 billion would be attributable to new traffic [63]. In the same study, it was also stated that even without allowing for the projected surge in coal use, cumulative railroad capital requirements in the period 1976 to 1985 had been estimated by the Interstate Commerce Commission (in Ex Parte No. 271) at more than \$42 billion; of this amount, over \$35 billion represented equipment needs.

Estimates of this magnitude indicate the need for railroad investment in the short-term considerably in excess of the level in recent years. It is unclear to what extent such investment could be attributed to the anticipated increase in coal transportation.

One indication of the magnitude of the investment required to meet this increase is provided by estimating the needs for capital investment in equipment between 1978 and 1990.

Freight car requirements other than for hopper cars are such that investment is required only for normal replacement of equipment. Investment in hopper cars, on the other hand, is required to replace existing rolling stock with larger capacity cars and to increase the size of the fleet due to increased coal transportation. Assuming a unit cost of \$30,000 [61,64], this investment has been estimated at \$7.5 billion through 1990; of this amount, \$2.3 billion would be attributed to increased coal traffic. Similarly, the increase in investment required in locomotives is estimated at \$12.5 billion (based on a unit cost of \$0.5 million [64]) of which \$2.8 billion would be attributed to increase coal traffic. The total investment in equipment through 1990 is estimated, therefore, at \$20 billion, of which \$5.1 billion would be attributed to increased coal traffic.

In addition, an investment would have to be made in upgrading and constructing railroad lines. The size of this investment can only be estimated on an order-of-magnitude basis.

Currently, there are approximately 324,000 miles of railroad track comprising 202,000 miles of railroad lines. Of this latter total, approximately 94,000 miles are branch lines. By assuming that the difference between track mileage and line mileage represents existing double-track line, it is estimated that 47,000 miles of main lines are single track. Therefore, an upper bound of potential investment in upgrading single-track to double-track lines can be established; this investment would be \$47 billion or \$1 million per mile [60], to upgrade the national rail transportation network in this way. A lower bound may be established by assuming that only main lines in the seven western coal-producing states would require such upgrading and that all such lines are currently single-track. The latter assumption is made to allow for the additional investment in constructing

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new branch lines in states as required. The lower bound is thus established at approximately \$12 billion (based on 12,400 miles of main lines). The investment required in new track is, therefore, estimated to be on the order of \$12 to \$47 billion.

In addition, upgrading existing trackage would be required. At \$0.5 million per mile for upgrading, the investment required would be on the order of \$5 to \$108 billion. The potential total investment in the trackage of the railroad network would therefore be from \$17 to \$155 billion. The lower bound of this order-of-magnitude estimate is more properly associated with increased coal traffic in the west through 1990. The upper bound represents potential investment in the railroad system that could be made to accommodate future growth in all railroad traffic, including further increases in coal traffic beyond 1990.

However, even the smaller of the above estimated investments, \$17 billion, would increase the investment required of the railroad industry by approximately 50 percent over the level of the last decade and would have even greater impact on the specific railroad companies required to make the investment.

Further, the railroad industry's current financial posture is relatively anemic. Earnings have been inadequate—three percent of operating revenues before payment of fixed charges and an overall deficit after fixed charges—and the rate of return on equity capital has been low (about two percent in this decade [66]). The shortage of internally generated funds has led to the deferment of road maintenance and the delay of road capital improvements by many railroads [63], and an increased reliance on equipment debt and lease obligations [70]. Therefore, future investments of the magnitude indicated—approximately \$1 billion per year through 1990 would have to be met through externally generated funds. While equipment trust certificates could be the means to acquire investment funds for freight cars and locomotives, the yield required might have to rise [61]. At the same time, the rate of return of railroad companies would have to increase to attract funds for investment in rights-of-way.

Environmental Impacts. The major impacts resulting from the transportation of coal by rail have been summarized in Table 5-64. These impacts are shown for a base year (1976) and for 1985 and 1990 in terms of the production projections under the no new leasing and the lease to meet DOE production goals alternatives. It should be noted that increases in future years, under either alternative, over the base year, would be directly proportional to the projected increase in coal traffic, i.e., about 70 percent in 1985 and about 140 percent in 1990. The other program alternatives would have changes in residual levels of the same order of magnitude, as presented in Table 5-64.

For the purpose of this statement, however, the differences in estimated impacts between the two alternatives presented is of greater interest. In 1985, these differences would be less than one percent and, therefore, negligible. In 1990, the proportionate increase would be higher—on the order of three percent—for all aspects considered, but it is still considered to be insignificant.

Non-quantifiable impacts of increased coal transportation by rail are perhaps more severe. These impacts relate to the movements of coal trains through rural areas and

communities along rail rights-of-way. Historically, major extensions of the rail network preceded the Nation's westward expansion, with many communities aggressively competing for initial rail access and improved rail service. In more recent years, however, there has been growing public concern regarding projected increases in coal movements, particularly in the West.

Rail/highway interface impacts relate to both the length and the number of unit trains. A 100-car unit train averages about 1.6 miles in length. The volume of train movements, particularly along the east-west lines through Montana and Wyoming, could be 50 trains a day by 1985 and 75 trains a day by 1990. Volumes of this magnitude would block non-separated rail/highway crossings for substantial portions of the day. Queuing of vehicular traffic would increase, thereby appreciably adding to the transit time required to traverse those communities built up along existing rail routes. Grade crossing fatalities could also increase. Blockage of grade crossings would also increasingly hinder the movement of emergency fire, police, and health vehicles.

The extent of the rail/highway crossing impacts would be highly site-specific, depending on the location of the rail line, volume of rail and vehicular traffic, and the type of rail crossing. Federal Railroad Administration standards for rail crossing protection devices are based in large part on rail and vehicular traffic volumes. In smaller communities, the local traffic volumes would be invariably too low to necessitate separated crossings or, in many instances, even flashing warning lights or crossing gates. Accordingly, communities desiring additional safety devices usually would be required to fund these improvements out of; (1) local and state tax revenues, (2) via a cooperative cost sharing or reimbursement with the railway company, or (3) through matching fund programs with the state highway department or agency. Various cost sharing programs are available such as the Matching Fund provisions for rail/highway grade crossing improvements from the U.S. Department of Transportation (DOT) under the Surface Transportation Assistance Act of 1978 and the Highway Safety Act of 1973.

For new rail extensions, however, there is greater flexibility for advance planning for separated crossings. For example, the Interstate Commerce Commission certificate authorizing the construction of the rail line connecting Gillette and Douglas, Wyoming, required adequate ingress and egress for local residents. As a result, more separated crossings are being constructed than were contemplated in the initial engineering plan.

Methods of expanding the rail network in the western coal regions also would have the potential to disrupt plans for the orderly development of local coal resources envisioned under the Federal coal management program alternatives. It is possible to construct major new rail lines without prior authorization from the Federal Government [67]. This can be accomplished in a number of ways:

- Aligning new rights-of-way to avoid Federal lands.
- Constructing spur lines rather than branch line extensions, thereby avoiding the certification processes under the Interstate Commerce Act.
- Construction of new lines by coal companies rather than rail carriers (coal companies are not common

TABLE 5-64

MAJOR RAIL TRANSPORTATION ENVIRONMENTAL RESIDUALS MEDIUM COAL PRODUCTION LEVEL

YEAR AND ALTERNATIVE	AIR EMISSIONS (Thousand Tons)					NUMBER OF FATALITIES	OPERATING ENERGY (10 ¹² Btu)
	TSP	HC	CO	SO	NO		
1976 Base Year	21.3	81.0	112.5	49.2	320.3	132	231.8
1985: No New Leasing Alternative	36.2	136.5	188.9	82.8	538.0	221	389.5
Meet DOE Projections Alternative	36.3	137.0	189.3	82.9	539.1	222	390.2
Change in Residuals	0.1	0.5	0.4	0.1	1.1	1	0.7
1990: No New Leasing Alternative	50.1	189.3	261.6	114.9	744.9	306	539.7
Meet DOE Projections Alternative	51.8	194.5	269.4	118.1	766.8	317	554.4
Change in Residuals	1.7	5.2	7.8	3.2	1.9	11	14.7

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carriers by rail subject to the Interstate Commerce Act).

Once private rail lines are in place, there is typically greater pressure to lease and develop additional coal reserves in areas possessing adequate rail access as opposed to reserves in areas lacking such access. One coal management program policy suboption (see Section 5.4) would limit new Federal leases to areas with established transportation access. However, this might have limited utility as long as the industry can construct private rail lines to private coal reserve areas. The option would, thus, tend to merely delay new leasing in limited access areas for the one to two years required to construct major rail extensions.

5.2.5.2 Waterways. During the last decade, shipments of coal by water have been on the order of 70 million tons per year while intermodal movements have involved the carriage of a further 35 to 40 million tons [71]. The greater part of these movements has involved the transportation of Appalachian coal via the Ohio and Mississippi River systems. It is anticipated that coal movements by water would increase in 1985 though the market share of shipments by this mode would decrease.

System Capacity. The carriage of coal by water takes place primarily on the inland waterways system developed by the U.S. Army Corps of Engineers. The important segment of this system for coal movement consists of the Ohio and Mississippi Rivers, constituting 9,000 miles of waterways, more than half of which are nine feet or deeper [61].

However, the annual capacity of this system is not a function of mileage or of channel depth; it is determined by the annual throughput of the locks that form part of the waterway. This, in turn, may be viewed in terms of undue delay, causing bottlenecks in the system. It has been stated that a waterway reaches capacity when the average delay time at a lock exceeds 150 minutes [72]. Certain locks already exceed or are close to exceeding design capacity [72]. These include the following locks.

- Locks 50 to 53 on the Ohio River.
- Locks 26 and 27 on the Upper Mississippi.
- All locks on the Illinois River system.
- Lock No. 3 on the Monongahela River.
- Winfield lock on the Kanawha River.

These are potential congestion points that would impede the flow of waterborne coal generated by increased production. In addition, a number of other points have been identified as potential problems [62]. The latter, however, are amenable to nonstructural solutions such as improved scheduling or helper boats [60]. The congestion points listed above would require long-term structural solution through the modification or replacement of the existing locks.

In terms of waterborne equipment for coal transportation i.e., barges and towboats, requirements for these additional vessels could be met as coal traffic grows through 1985 and beyond [60]. Projected 1985 waterborne coal traffic is about the current level and, therefore, equipment needs would be limited to replacements. Increased requirements through 1990 should pose no problem as sufficient shipbuilding capacity (1,400 barges per year and 40 towboats per year) can produce coal-dedicated equipment with the capacity to handle up to 250 million tons per year during the next decade.

Environmental Impacts. Projected volumes of waterborne coal indicate that environmental impacts would be negligible. However, some of these impacts are discussed below in qualitative terms; at the same time, it should be recognized that these impacts would be a function of total waterborne traffic rather and not associated specifically with the movement of coal.

The ambient atmosphere would be impacted to some degree in terms of air quality and noise pollution. Oil discharges from tugs are a potential source of water pollution. Increased traffic might increase turbidity and barge wash thus impacting aquatic and shoreline ecosystems. The dredging of river channels and the disposal of material therefrom may also impact these ecosystems. Finally, increased barge traffic would induce shoreline development to provide barge-related services; such development could result in secondary impacts on air and water quality and noise levels.

5.2.5.3 Highway Transportation. Coal transportation by highway would be limited to intrastate movements and to the movement of coal from mine to rail tippie or barge-loading facility. In either case, coal movement would be a short-line nature and, historically, has taken place predominantly in the Appalachian Coal Regions and to some degree in the Eastern Interior Coal Region. The impact of such movements, particularly in Appalachia, has been a matter of concern in the past, as coal trucks travel on local and secondary road systems inadequate to withstand repeated usage by heavy duty trucks, even where the gross vehicle weights are within posted limits [61]. A comprehensive study of highway needs related to energy activities, undertaken under Section 153 of the Federal-Aid Highway Act, found that an estimated \$4.1 billion was required for the restoration of highways used for energy resource handling in 1975. In the same study, 18 of the 24 states in which coal resources are located reported a total need for a further \$3.2 billion identified with increased coal production through 1985 [60]. To the extent that the preferred program and other program alternatives would decrease eastern coal production, further impacts on local highway systems, both in terms of roadway deterioration and traffic volume, would be mitigated. At the same time, it is anticipated that a need for new roadways to move coal and for the transportation of people and goods would emerge in the western coal producing states. The extent of this need cannot be quantified as it is dependent on the location of mines, transportation facilities, and communities developed or impacted.

In terms of equipment, i.e., heavy duty trucks, there would be no perceptible constraint on availability. Manufacturers are currently operating at 70 percent capacity, building just over 60,000 dump trucks annually [60]. Equipment requirements cannot be quantified as the extent of intermodal movements is unknown.

Environmental Impacts. Social, environmental, and safety impacts of highway movements of coal are already being experienced—most severely in Appalachia [60]. Such impacts could become more severe with increased coal production, but are not specifically attributable to any of the program alternatives. Perhaps the most important impact would be the perceived, rather than actual, impact of truck traffic on a local community—in terms of traffic volume, noise and vibrations,

coal spillage, and visual impacts. These impacts would require consideration in determining the need for highway improvement and additions, together with such mitigating measures as, for example, restricted routing of coal traffic.

Energy development impacts on transportation systems are currently being assessed by the National Energy Transportation Study Task Force by the Departments of Energy (DOE) and Transportation (DOT.) Their study is to analyze energy-related transportation problems and needs on a nationwide basis.

5.2.5.4 Coal Slurry Pipelines. The use of slurry pipelines for the transportation of coal is still in its infancy, although the technology is well developed. Only one such pipeline system, the Black Mesa slurry line with annual through-put of 4.8 million tons, is currently operational. Additional pipeline systems are in the process of being developed to provide transportation capacity of about 140 million tons per year. Due to the time required to plan, construct, and make coal slurry pipelines operational, and to resolve the issues surrounding the development of this industry, no significant coal pipeline transportation capacity is contemplated through 1990. One study suggests a total capacity of 200 million tons by the year 2000 [73].

The rate at which the coal slurry pipeline industry may develop is a matter of speculation due to the constraints imposed by several issues, primarily water availability and eminent domain.

Most of the proposed coal slurry pipelines originate in arid western states where water is already a scarce resource. In these areas, about 90 percent of the existing available water is used for agricultural purposes and the developing energy-related industries have to compete for water with recreation, domestic needs, and industrial activities, as well as farming. The process of coal slurring requires approximately 1 ton of water for each ton of coal. Based on the assumption that the slurry pipelines currently under developmental study become operational, there would be a need for approximately 100,000 acre-feet of water per year. While this quantity of water would be a small portion of available surface water, and additional water could be available from aquifers such as the one underlying the Madison formation, the exporting of such a valuable resource has met with opposition from Westerners. On the other hand, the developers of one of the larger proposed pipelines (ETSI) have already been assured of the availability of water by legislative action in Wyoming; this suggests that this issue might be resolved in the near future.

The question of eminent domain is equally controversial. To obtain rights-of-way for the proposed pipelines, proposals have been made at both the state and Federal levels to grant pipeline developers the right to exercise the power of eminent domain. While this proposal was recently rejected by the U.S. Congress, a number of western states have legislation that would permit the granting of such rights. However, it is difficult to assess future developments in this area.

Whether the above constraints on the development of coal slurry transportation will be continued or resolved remains a matter of speculation; therefore, the potential impacts of this mode of transportation cannot be assessed at this time. It can, however, be stated that the environmental impacts of slurry pipelines, with the exception of water

requirements, are generally of more concern during the construction of the pipelines rather than during operation. The impacts associated with pipelines, both during construction and operation, have been generally assessed in a recent study. Because of the underground nature of the pipeline system various impact aspects are typically of most impact during the construction phase [73].

5.2.6 Operating Energy

It takes energy to produce energy. Thus, during all phases of the coal cycle, energy would be expended. The energy expended in this way, defined as operating energy, is in the form of coal, oil (mainly diesel oil), gas, and electricity. In order to determine how much operating energy would be required, the heat content of these energy forms is equated to the heat content of the coal that would be recovered. To simplify the comparisons, operating energy is expressed in terms of its heat equivalent in British thermal units (Btus). Appendix H presents additional detail on how this conversion is derived.

The discussion that follows presents background material describing operating energy in terms of phases of the energy cycle, followed by an analysis of operating energy requirements on a regional basis for the seven program alternatives.

5.2.6.1 Coal Extraction. During coal extraction, energy is consumed by cutting and loading devices, such as drills, mining machines, draglines, crawler-type loaders, and shuttle cars. In underground mining, greater use is being made of continuous mining machines which can cut the coal loose and load it in one operation. Mine cars, conveyors, and shuttle cars are used to bring coal to the surface. Strip mining operations employ equipment such as shovels, dragline and wheel excavators, scrapers, bulldozers, loaders, and drills. In auger mining, giant coal augers are used to reach coal that cannot be strip mined because there is too much overburden. All mining methods would use various forms of electric and diesel engines to power equipment. The overall operating energy that would be expended in this phase of the coal cycle is assumed to be 4 percent of the Btu content of the coal in place [71,74].

5.2.6.2 Beneficiation. Energy would also be consumed in the refining and processing of coal. The major operations involved are crushing, screening, wet and dry washing, and thermal drying. The overall operating energy expended for coal cleaning is assumed to be 0.7 percent for crushing and screening and 4.6 percent for mechanically cleaned and dried coal [71,75].

5.2.6.3 Coal Transport. Energy would be consumed by trains, trucks, barges, and slurry pipelines to move coal from the production and beneficiation facilities to other locations in the coal cycle. The operating energy expended in the transportation phase is measured in Btus consumed per ton-mile transported. It is quantified as a function of the mode of transport as follows [76]:

- 670 Btus/ton-mile for rail transport,
- 680 Btus/ton-mile for barge transport,
- 2800 Btus/ton-mile for truck transport, and
- 450 Btus/ton-mile for slurry pipeline transport.

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5.2.6.4 Coal Conversion and Utilization. Energy would be expended in coal conversion and utilization facilities to operate equipment such as pumps, cooling towers, and pollution control devices. The operating energy required during this phase is assumed to be as follows [39,45]:

- 3 percent for steam electric power plants,
- 2 percent for gasification plants,
- 0.9 percent for liquefaction plants, and
- 2.7 percent for coke plants.

5.2.6.5 Efficiency of the Coal Cycle. Based on the above factors, operating energy can be calculated for each phase of the coal cycle. For example, for every 100 Btus present in the coal in the ground, 4 percent or 4 Btus would be expended in extracting the coal. Thus, a net of 96 Btus would be brought from the mine. During beneficiation, as much as 4.4 Btus would be expended (4.6 percent of 96 Btus delivered for processing) resulting in a net of 91.6 Btus after this phase. Assuming that transportation would take approximately another 1 Btu (1 percent of 98.6 Btus), of the original 100 Btus about 90.6 Btus would be available for conversion and utilization. For example, in an electric power plant, 2.7 Btus (or 3 percent of the plant input) would be used to operate the plant and 88 Btus would be the net feed to the plant to be converted to electric power. The flow chart in Figure 5-6 summarizes this discussion.

It is important to note that the Btu loss due to coal conversion into synthetic gas or liquid fuels, or coal utilization to generate electric power, or to make coke is distinct from the operating energies considered in this section. For example, the thermal efficiency of steam/electric power plants is 35 percent on the average; for every 100 Btus in the coal, only about 35 Btus of electricity would be generated. Similarly, the average thermal efficiency of coke plants is 70 percent, of gasification plants 65 percent, and of liquefaction plants 69 percent [1,39].

5.2.6.6 Operating Energy Requirements. Estimates of operating energy expended during coal cycle activities are presented in Table 5-65. The table indicates energy that would be expended at the low, medium, and high production projections of the base case (no new leasing alternative) for the years 1985 and 1990. Also presented in the table are the differences in operating energies between the no new leasing alternative and the other coal management program alternatives by year and by region. Differences between regions for a given alternative may vary substantially. For example, in 1985 at the medium production projection for the no new leasing alternative, the range between the Northern Appalachia and Denver-Raton Mesa Coal Regions is 415.8 trillion Btus (TBtus). This is equivalent to the combustion of about 19 million more tons of coal in the Northern Appalachia Coal Region. As can be seen below, greater levels of production and consumption in the Northern Appalachian Coal Region would result in higher operating energy expenditures.

	Northern Appalachian Region	Denver- Raton Mesa Region
1985 Production (tons)	211,700,000	5,000,000
1985 Consumption (tons)	182,900,000	20,100,000

In 1985, in the Green River-Hams Fork Coal Region, the lease to meet industry needs alternative would have the greatest increase in operating energy: 38.6 TBtus or about 1.75 million tons of coal equivalent. This would be due in part to a 47 percent increase in coal production in that region over the no new leasing baseline. Differences in operating energies between the no new leasing alternative and all other alternatives by year and by region are presented in Table 5-66. Table 5-66.

For the year 1990, the greatest increases in operating energy are in the Powder River Region (for the preferred alternative medium level), equivalent to about 4.5 million tons of coal. This increase resulted from a 31 percent increase in coal production.

In summary, wherever coal production, consumption, or transportation increases, operating energy expended will increase. On the average, about 10 percent of the energy in coal is consumed during the coal cycle as operating energy.

5.3 Regional Impact Summary Comparison

This section presents a brief comparison of the effects of the several coal management alternatives on each coal region. Each value is calculated as the ratio of the difference between the alternative of interest and the no new leasing alternative. The medium production projections are used in this comparison. The tabular displays in Tables 5-67 and 5-68 highlight differences greater than plus or minus five percent with an asterisk (*). As in the previous portion of Chapter 5, the ratios are based on regional coal production and consumption projections derived from the National Coal Model and upon estimates of environmental residuals from the Department of the Interior's Coal Impact Estimation Program (CIEP). The magnitude of impacts associated with these residuals on the regional environments would depend on an interaction of the residuals and on a variety of site-specific factors. Accordingly, the reader of this section should refer back to prior impact analyses and related appendices to obtain a better comprehension of impacts. Factors chosen for comparison are:

COAL:	Annual production.
LAND:	Annual land disturbance.
WATER:	Annual water use in acre/feet.
AIR:	Annual air emissions of criteria pollutants.
POPULATION:	Coal-related population.
AGRICULTURE:	Value of crops lost to mining.
ENERGY:	Operating energy used in coal-related activities.

Tables 5-67 and 5-68 display the changes in each of the factors from the no new leasing alternative for the preferred program and each of the other alternatives under the 1985 and 1990 medium production projections. The tabular displays

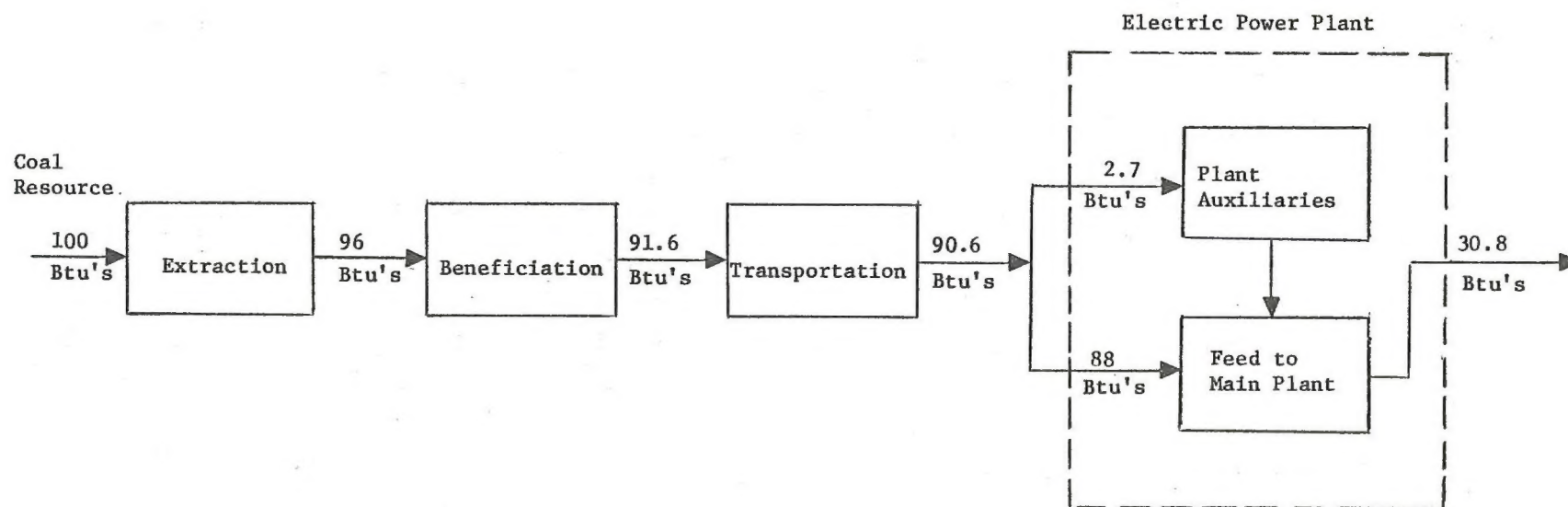


FIGURE 5-6

OPERATING ENERGY IMPACTS ON THE COAL CYCLE

TABLE 5-65

NO NEW LEASING ALTERNATIVE, OPERATING ENERGY IMPACTS
(trillion Btus)

COAL REGION	1976 (a) BASELINE	LOW PRODUCTION LEVEL		MEDIUM PRODUCTION LEVEL		HIGH PRODUCTION LEVEL	
	ABSOLUTE VALUES	1985- 1976	1990- 1985	1985- 1976	1990- 1985	1985- 1976	1990- 1985
Northern Appalachian	384.0	73.0	-16.0	85.0	50.0	96.0	174.0
Central Appalachian	338.0	13.0	-1.0	26.0	41.0	-9.0	132.0
Southern Appalachian	82.8	23.2	1.0	23.2	19.0	82.2	46.0
Eastern Interior	289.0	183.0	130.0	188.0	231.0	140.0	350.0
Western Interior	104.0	65.0	16.0	96.0	100.0	106.0	173.0
Texas	52.6	111.4	34.0	149.4	150.0	138.4	220.0
Powder River	59.4	130.6	33.0	190.6	118.0	266.6	80.6
Green River-Hams Fork	44.8	25.6	31.6	67.2	32.0	93.2	31.4
Fort Union	36.6	18.3	14.5	35.9	46.5	69.4	67.0
San Juan River	17.1	7.9	17.6	19.6	48.1	40.2	56.9
Uinta-Southwestern Utah	20.4	16.5	14.4	38.4	28.8	61.8	36.9
Denver-Raton Mesa	25.7	17.3	15.9	27.5	30.9	37.7	35.4

(a) Represents absolute values; other columns represent differences from 1976 baseline levels.

TABLE 5-66

OPERATING ENERGY, COMPARISON OF ALTERNATIVES
(trillion Btu's)

COAL REGION	PROGRAM ALTERNATIVES										
	NO NEW LEASING (a)			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	1985			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	457.0	469.0	480.0	0	-0.226	0.30	-5.76	-5.77	-5.52	-0.157	-6.18
Central Appalachian	351.0	364.0	329.0	-0.180	-1.66	3.25	-0.210	-1.07	-15.0	-2.48	7.04
Southern Appalachian	106.0	141.0	165.0	-0.131	-2.76	-1.95	-2.47	-1.12	5.72	-9.73	-7.45
Eastern Interior	472.0	477.0	429.0	-0.194	4.81	-16.60	-0.637	1.09	-14.9	-6.42	9.89
Western Interior	169.0	200.0	210.0	-0.585	-3.89	7.78	-4.88	-3.76	-4.38	-1.90	-1.08
Texas	164.0	202.0	191.0	0	2.67	-16.6	-1.17	0.160	-13.7	-6.73	17.3
Powder River	190.0	250.0	326.0	-0.113	0.318	26.8	0.115	0.233	22.3	-0.179	-21.5
Green River-Hams Fork	70.4	112.0	138.0	0	4.65	32.1	2.04	1.10	38.6	37.8	-18.5
Fort Union	54.9	72.5	106.0	1.31	1.46	0.843	1.44	1.49	8.39	-9.57	8.04
San Juan River	25.0	36.7	57.3	0	0.243	0.423	0	0	5.92	-3.92	8.06
Uinta-Southwestern Utah	36.9	36.8	82.2	0	0.814	0.982	0.520	0.257	8.23	-4.27	0.116
Denver-Raton Mesa	43.0	53.2	63.4	-0.136	0.587	1.01	0.520	0.588	3.89	3.89	2.61
	1990			CHANGE FROM NO NEW LEASING VALUE							
Northern Appalachian	441.0	519.0	654.0	3.12	1.50	-3.6	-0.54	-0.478	-0.985	5.71	7.06
Central Appalachian	350.0	405.0	461.0	0	-5.52	-19.2	0	-1.71	-8.67	-5.24	15.3
Southern Appalachian	107.0	160.0	221.0	0	-0.947	5.99	0.65	-0.192	7.16	-15.9	-19.1
Eastern Interior	602.0	708.0	779.0	-1.4	-16.5	-76.9	-2.81	-6.01	-69.4	-19.2	74.2
Western Interior	185.0	300.0	383.0	0	-8.58	-40.0	-10.3	-5.0	-11.5	-11.7	2.69
Texas	198.0	352.0	411.0	-1.09	-33.6	-50.4	-5.85	-6.28	-63.1	-40.0	-11.8
Powder River	223.0	368.0	407.0	0.18	98.7	278.0	51.1	10.8	151.0	95.3	-37.7
Green River-Hams Fork	102.0	144.0	169.0	3.99	22.6	61.2	1.75	4.55	54.1	53.3	-37.9
Fort Union	69.4	119.0	173.0	0	-8.63	-10.4	-3.22	0	3.72	-30.2	3.67
San Juan River	42.6	84.8	114.0	0.607	-9.98	-1.69	-4.43	-1.04	1.42	7.82	4.51
Uinta-Southwestern Utah	51.3	87.6	119.0	1.06	-7.02	-5.43	-5.63	-0.998	6.20	-26.6	-10.6
Denver-Raton Mesa	58.9	84.1	98.8	0.57	0.330	14.5	-0.13	-0.539	0.831	-5.96	-2.04

(a) Represent absolute values; other columns represent differences from the no new leasing base case.

TABLE 5-67

SUMMARY OF PERCENT OF CHANGE BY ALTERNATIVE FROM NO NEW LEASING
MEDIUM PRODUCTION PROJECTION
(1985)

COAL REGION	COAL	LAND	WATER	AIR	POPULA- TION	AGRICUL- TURE	OPERATING ENERGY
NORTHERN APPALACHIAN							
Preferred	0	0	0	0	0	0	0
PRLAs ONLY	0	- 2.7	- 4.3	- 3.9	- 1.9	- 3.0	- 1.2
Short-term	0	- 2.8	- 4.3	- 3.9	- 2.0	- 3.0	- 1.2
Industry Needs	- 0.7	- 2.9	- 4.4	- 3.6	- 2.1	- 3.0	- 1.1
DOE Targets	- 0.1	0	0	0	0	0	0
State Determination	- 0.3	- 2.8	- 4.3	- 3.8	- 2.0	- 3.0	- 1.3
CENTRAL APPALACHIAN							
Preferred	- 0.5	- 0.7	- 0.7	- 0.6	- 0.5	- 0.8	- 0.5
PRLAs Only	0	- 0.2	- 0.5	- 0.4	- 0.1	0	- 0.1
Short-term	- 0.3	- 0.7	- 0.6	- 0.5	- 0.4	0	- 0.3
Industry Needs	- 6.3*	- 3.9	- 1.0	- 0.3	- 4.6	- 3.2	- 4.1
DOE Targets	- 1.0	- 0.8	- 0.4	- 0.3	- 0.7	- 0.8	- 0.7
State Determination	+ 2.6	+ 1.1	- 0.4	- 0.3	+ 1.7	- 0.8	- 1.9
SOUTHERN APPALACHIAN							
Preferred	- 3.3	- 2.0	- 2.0	- 1.7	- 2.2	- 2.0	- 2.0
PRLAs Only	- 3.8	- 1.5	- 1.3	- 1.2	- 1.8	- 2.5	- 1.8
Short-term	0	- 1.4	- 1.6	- 1.4	- 1.2	- 1.5	- 0.8
Industry Needs	+14.9*	- 0.2	- 1.7	- 1.2	+ 1.8	- 0.8	+ 4.1
DOE Targets	-24.4*	- 5.2*	- 3.4	- 3.0	- 6.9*	- 4.4	- 6.9*
State Determination	-19.6*	- 3.2	- 1.7	- 1.5	- 4.9	- 2.5	-10.1*
EASTERN INTERIOR							
Preferred	+ 1.7	+ 0.5	- 0.1	- 0.1	+ 0.7	0	+ 1.0
PRLAs Only	- 0.1	- 0.2	- 0.3	- 0.3	- 0.2	0	- 0.1
Short-term	+ 0.5	0	- 0.2	- 0.2	+ 0.1	0	- 0.2
Industry Needs	- 5.1*	- 0.8	+ 0.1	+ 0.4	- 2.4	- 0.5	- 3.1
DOE Targets	- 1.3	- 2.4	- 2.6	- 2.6	- 1.8	- 2.4	- 1.3
STATE Determination	+ 3.2	+ 0.4	- 0.5	- 0.5	+ 1.4	0	+ 2.1
WESTERN INTERIOR							
Preferred	- 4.4	- 4.1	- 4.0	- 3.3	- 3.7	- 4.1	- 1.9
PRLAs Only	- 3.6	- 5.3*	- 5.5*	- 4.5	- 4.9	- 5.4*	- 2.4
Short-term	0	- 4.6	- 5.0*	- 4.1	- 4.3	- 4.8	- 1.9
Industry Needs	-42.3*	- 6.0*	- 1.6	- 0.8	+ 3.6	- 3.8	- 2.2
DOE Targets	-24.0*	0	+ 3.0	+ 2.5	+ 1.0	+ 1.4	- 1.0
State Determination	+11.3*	- 3.6	- 5.3*	- 4.2	- 3.6	- 4.5	- 0.5
TEXAS							
Preferred	+ 3.6	+ 1.1	+ 0.4	+ 0.4	+ 0.7	+ 0.6	+ 1.3
PRLAs Only	- 0.5	- 0.7	- 0.8	- 0.8	- 0.8	- 0.8	- 0.6
Short-term	+ 0.9	- 0.1	- 0.4	- 0.4	- 0.3	- 0.3	- 0.1
Industry Needs	-27.5*	- 5.7*	- 1.5	- 1.2	- 4.3	- 2.9	- 6.3*
DOE Targets	-10.9*	- 2.4	- 0.5	- 0.4	- 1.9	- 1.0	- 3.3
State Determination	+22.8*	+ 6.5*	+ 2.3	+ 2.2	+ 5.0*	+ 3.7	+ 8.6*

Note: Asterisks (*) denote differences exceeding $\pm 5\%$.

TABLE 5-67
(Concluded)

SUMMARY OF PERCENT OF CHANGE, BY ALTERNATIVE FROM NO NEW LEASING
MEDIUM PRODUCTION PROJECTION
(1985)

COAL REGION	COAL	LAND	WATER	AIR	POPULA- TION	AGRICUL- TURE	OPERATING ENERGY
SAN JUAN RIVER							
Preferred	+ 0.8	+ 0.3	0	0	+ 0.6	0	+ 0.7
PRLAs Only	0	- 0.2	- 0.5	- 0.5	- 0.4	0	0
Short-term	0	- 0.2	- 0.5	- 0.5	- 0.4	0	0
Industry Needs	+ 21.0*	+ 13.2*	+ 0.8	+ 1.3	+ 10.6*	+ 9.4*	+ 16.1*
DOE Targets	- 10.9*	- 11.4*	- 13.3*	- 12.1*	- 13.5*	- 11.7*	- 10.7*
State Determination	+ 29.0*	+ 18.6*	+ 1.3	+ 1.6	+ 14.2*	+ 14.1*	+ 22.0*
UINTA-SOUTHWESTERN UTAH							
Preferred	- 24.3*	+ 2.7	+ 2.7	+ 1.3	+ 1.7	0	+ 1.4
PRLAs Only	- 24.3*	+ 0.7	+ 0.4	+ 0.2	+ 0.7	0	+ 0.9
Short-term	+ 0.3	+ 1.1	+ 1.1	+ 0.5	+ 0.6	0	+ 0.4
Industry Needs	- 11.2*	+ 6.6*	+ 4.4	+ 2.2	+ 11.8*	0	- 14.0*
DOE Targets	- 33.3*	+ 0.6	+ 2.3	+ 1.1	- 5.1*	0	- 7.3*
State Determination	- 25.8*	+ 2.1	+ 2.7	+ 1.3	+ 1.1	0	+ 0.2
GREEN RIVER-HAMS FORK							
Preferred	+ 5.3*	+ 4.4	+ 3.0	+ 2.2	+ 4.3	0	+ 4.2
PRLAs Only	+ 2.5	+ 1.3	- 0.6	- 0.5	+ 1.6	0	+ 1.8
Short-term	+ 1.3	+ 1.0	+ 0.3	+ 0.2	+ 0.9	0	+ 1.0
Industry Needs	+ 47.4*	+ 36.1*	+ 9.0*	+ 8.9*	+ 29.5*	+ 25.0*	+ 34.5*
DOE Targets	+ 47.4*	+ 35.6*	+ 7.6*	+ 7.0*	+ 28.9*	+ 25.0*	+ 33.8*
State Determination	- 24.4*	- 17.7*	- 0.9	- 1.2	- 13.0*	- 12.5*	- 16.5*
POWDER RIVER							
Preferred	+ 0.1	+ 0.2	0	+ 0.1	+ 0.5	0	+ 0.1
PRLAs Only	+ 0.1	+ 0.1	0	- 0.1	+ 0.1	0	0
Short-term	+ 0.1	+ 0.1	0	0	+ 0.2	0	+ 0.1
Industry Needs	+ 9.9*	+ 8.1*	+ 4.2	+ 4.5	+ 8.9*	0	+ 8.9*
DOE Targets	- 0.1	- 0.4	- 1.4	- 0.8	0	0	- 0.1
State Determination	- 10.4*	- 7.8*	- 3.5	- 2.6	- 8.0*	0	- 8.6*
DENVER-RATON MESA							
Preferred	0	+ 4.3	+ 4.9	+ 2.7	+ 3.4	0	+ 1.1
PRLAs Only	0	+ 4.1	+ 4.7	+ 2.6	+ 3.4	0	+ 1.1
Short-term	0	+ 4.1	+ 4.7	+ 2.7	+ 3.4	0	+ 1.1
Industry Needs	+ 20.0*	+ 15.3*	+ 9.8*	+ 7.3*	+ 8.6*	0	+ 7.3*
DOE Targets	+ 20.0*	+ 24.0*	+ 19.6*	+ 11.5*	+ 14.8*	+ 16.7*	+ 7.5*
State Determination	+ 40.0*	+ 6.3*	- 0.6	0	+ 4.2	0	+ 4.9
FORT UNION							
Preferred	0	+ 7.5*	+ 14.2*	+ 8.8*	+ 7.0*	0	+ 2.0
PRLAs Only	0	+ 7.5*	+ 14.3*	+ 8.8*	+ 7.0*	0	+ 2.0
Short-term	0	+ 7.5*	+ 14.3*	+ 8.9*	+ 7.0*	0	+ 2.1
Industry Needs	+ 15.7*	+ 17.9*	+ 23.3*	+ 15.7*	+ 16.4*	+ 16.7*	+ 11.6*
DOE Targets	- 31.4*	- 11.4*	+ 1.8	+ 1.0	- 8.7*	0	- 13.2*
State Determination	+ 17.2*	+ 18.8*	+ 22.7*	+ 14.7*	+ 16.7*	+ 16.7*	+ 11.1*

Note: Asterisks (*) denote differences exceeding $\pm 5\%$.

TABLE 5-68

SUMMARY OF PERCENT OF CHANGE BY ALTERNATIVE FROM NO NEW LEASING
MEDIUM PRODUCTION PROJECTION
(1990)

COAL REGION	COAL	LAND	WATER	AIR	POPULA- TION	AGRICUL- TURE	OPERATING ENERGY
NORTHERN APPALACHIAN							
Preferred	+ 0.3	+ 1.2	+ 0.1	+ 0.2	+ 0.2	0	+ 0.3
PRLAs Only	0	- 0.3	0	0	- 0.1	0	+ 0.1
Short-Term	+ 0.1	0	0	0	0	0	+ 0.1
Industry Needs	- 0.8	- 0.2	0	+ 0.2	- 0.3	0	- 0.2
DOE Targets	+ 1.3	+ 0.4	0	+ 0.3	+ 0.7	+ 0.5	+ 1.1
State Determination	+ 2.7	+ 0.6	+ 0.1	- 0.1	+ 7.8*	0	+ 1.4
CENTRAL APPALACHIAN							
Preferred	- 2.4	- 1.0	- 0.1	+ 0.1	- 1.5	+ 0.6	- 1.4
PRLAs Only	- 0.3	+ 1.0	+ 1.7	+ 1.5	+ 0.3	- 0.6	0
Short-Term	- 0.6	- 0.2	0	0	- 0.4	0	- 0.4
Industry Needs	- 3.9	- 0.4	+ 0.6	+ 1.0	- 2.3	0	- 2.1
DOE Targets	+ 2.7	- 1.2	- 0.3	+ 0.2	- 1.6	+ 0.6	- 1.3
State Determination	+ 6.7*	+ 1.2	- 2.1	- 2.2	+ 3.4	0	+ 3.8
SOUTHERN APPALACHIAN							
Preferred	- 3.8	- 0.3	0	+ 0.1	- 0.9	- 0.2	- 0.6
PRLAs Only	- 0.4	+ 0.9	+ 1.0	+ 0.9	+ 0.8	0	+ 0.4
Short-Term	0	+ 0.1	+ 0.1	0	+ 0.1	+ 0.1	- 0.1
Industry Needs	+ 15.2*	+ 1.6	+ 0.6	+ 0.3	+ 3.4	+ 1.1	+ 4.5
DOE Targets	- 45.1*	- 3.4	- 0.3	+ 0.1	- 8.6*	- 1.9	- 9.9*
State Determination	- 45.9*	- 4.7	- 1.6	- 1.5	- 9.9*	- 3.1	- 11.9*
EASTERN INTERIOR							
Preferred	- 3.6	- 1.2	- 0.2	- 0.1	- 2.0	- 0.9	- 2.3
PRLAs Only	- 5.2*	- 1.0	- 0.2	- 0.1	- 3.2	- 0.9	- 0.4
Short-Term	- 1.1	- 0.8	- 0.5	- 0.5	- 0.8	0	- 0.8
Industry Needs	- 14.2*	- 4.4	- 0.6	- 0.2	- 8.1*	- 4.3	- 9.8*
DOE Targets	- 5.8*	- 3.0	- 0.1	+ 0.3	- 2.5	- 1.7	- 2.7
State Determination	+ 15.0*	+ 3.9	- 0.1	- 0.5	+ 9.4*	+ 4.3	+ 10.5*
WESTERN INTERIOR							
Preferred	- 33.0*	- 2.5	- 0.1	+ 0.1	- 2.4	- 1.3	- 2.9
PRLAs Only	- 24.4*	- 3.0	- 2.3	- 2.0	- 3.7	- 3.1	- 3.4
Short-Term	- 5.1*	- 2.4	- 2.3	- 2.0	- 2.3	- 2.4	- 1.7
Industry Needs	- 60.0*	- 1.7	- 2.7	+ 2.7	- 1.8	+ 0.6	- 3.8
DOE Targets	- 60.4*	- 2.8	- 2.1	+ 2.3	- 2.4	- 0.3	- 3.9
State Determination	+ 37.3*	- 3.1	- 5.5	- 4.9	- 2.2	- 0.4	+ 0.9
TEXAS							
Preferred	- 27.9*	- 6.0	- 0.2	- 0.2	- 4.3	- 2.1	- 9.5*
PRLAs Only	- 2.6	- 1.8	- 1.6	- 1.6	- 1.4	- 1.7	- 1.7
Short-Term	- 3.1	- 1.7	- 1.4	- 1.3	- 1.6	- 1.5	- 1.8
Industry Needs	- 50.7*	- 12.1*	- 1.8	- 1.8	- 8.8*	- 5.2*	- 17.9*
DOE Targets	- 33.3*	- 7.6*	- 0.8	- 0.7	- 5.4*	- 3.0	- 11.4*
State Determination	- 7.0	- 2.6	- 1.4	- 1.4	- 2.2	- 1.8	- 3.4

Note: Asterisks (*) denote differences exceeding $\pm 5\%$.

TABLE 5-68
(Concluded)

SUMMARY OF PERCENT OF CHANGE BY ALTERNATIVE FROM NO NEW LEASING
MEDIUM PRODUCTION PROJECTION
(1990)

COAL REGION	COAL	LAND	WATER	AIR	POPULA- TION	AGRICUL- TURE	OPERATING ENERGY
SAN JUAN RIVER							
Preferred	-15.9*	-11.2*	+ 1.5	- 1.1	- 8.2*	- 9.1*	-11.8*
PRLAs Only	- 7.6	- 5.2*	+ 0.6	- 0.7	- 3.4	- 4.1	- 5.2*
Short-Term	- 1.7	- 1.4	+ 1.0	- 1.0	- 1.0	0	- 1.2
Industry Needs	+ 1.0	- 1.1	+ 0.4	+ 0.7	+ 1.7	0	+ 1.7
DOE Targets	- 2.9	- 3.9	- 0.7	- 1.9	-11.7*	- 2.9	- 9.2*
State Determination	+ 6.1*	- 4.2	- 1.2	- 0.8	+ 4.0	- 4.1	+ 5.3*
UINTA-SOUTHWESTERN UTAH							
Preferred	-12.2*	- 1.5	- 0.6	+ 0.1	- 6.3*	0	- 8.0*
PRLAs Only	- 6.7*	- 5.3*	- 5.5*	- 4.9	- 6.1*	0	- 6.4*
Short-Term	- 0.5	- 3.7	- 4.6	- 4.1	- 1.9	0	- 1.1
Industry Needs	+11.1*	+ 3.2	- 1.9	+ 1.8	+ 6.0*	0	+ 7.1*
DOE Targets	-37.2*	- 9.1*	- 1.7	- 1.7	-25.7*	0	-30.4*
State Determination	-18.3*	- 5.7*	- 4.3	- 3.8	-10.4	0	-12.1*
GREEN RIVER-HAMS FORK							
Preferred	+21.6*	+16.7*	+ 2.6	+ 3.0	+13.7*	+10.0*	+15.7*
PRLAs Only	+ 2.3	- 0.8	- 7.0*	- 4.3	- 0.1	0	- 1.2
Short-Term	+ 5.6*	+ 1.9	- 7.5*	- 4.7	+ 1.0	0	+ 3.2
Industry Needs	+ 5.2*	+41.6*	+ 8.3*	+ 8.2*	+32.8*	0	+37.6*
DOE Targets	+51.5*	+40.4	+ 5.6*	+ 6.8*	+31.7*	+30.0*	+37.0*
State Determination	-36.4	-31.6	-11.5	- 9.2*	-23.6*	0	-26.3*
POWDER RIVER							
Preferred	+31.1*	+23.1*	+ 7.5*	+ 7.8*	+26.0*	+18.2*	+26.7*
PRLAs Only	+16.4*	+11.6*	+ 3.3	+ 3.6	+12.9*	0	+13.9*
Short-Term	+ 3.6	+ 2.0	- 0.6	- 0.1	+ 2.6	0	+ 2.9
Industry Needs	+47.5*	+35.5*	+12.5*	+12.7*	+39.6*	0	+41.0*
DOE Targets	+29.9*	+22.2*	+ 7.2*	+ 8.1*	+25.0*	+18.2*	+25.9*
State Determination	-11.8*	- 9.3*	- 5.4*	- 4.5*	- 9.6*	- 9.1*	-10.2*
DENVER-RATON MESA							
Preferred	- 6.6*	+ 0.2	0	+ 0.5	- 0.5	0	+ 0.4
PRLAs Only	- 1.9	- 1.8	- 2.4	- 1.3	0	0	- 0.2
Short-Term	- 1.0	- 1.5	- 1.8	- 1.3	- 1.2	0	- 0.6
Industry Needs	- 6.6*	+ 6.2*	- 2.7	+ 2.5	- 1.4	0	+ 1.0
DOE Targets	-30.0*	+ 0.5	+ 2.7	+ 2.4	-11.5*	0	- 7.1*
State Determination	- 3.8	- 5.5*	- 7.2*	- 4.8	- 4.9	0	- 2.4
FORT UNION							
Preferred	-17.9*	- 5.8*	- 0.5	- 0.1	- 4.8	0	- 7.3*
PRLAs Only	- 7.1*	- 1.3	- 1.5	+ 1.2	- 1.1	0	- 2.7
Short-Term	- 0.8	+ 1.3	+ 2.6	+ 1.9	+ 1.1	0	0
Industry Needs	+ 1.8	+ 1.5*	+ 6.9*	+ 5.8*	+ 4.9	0	+ 3.1
DOE Targets	-55.9*	-25.6*	-12.9*	- 9.0*	-21.0*	-15.4*	-25.4*
State Determination	+ 6.7*	+ 4.2	+ 3.7	+ 2.6	+ 3.5	0	+ 3.1

Note: Asterisks (*) denote differences exceeding \pm 5%.

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highlight differences greater than plus or minus five percent with an asterisk(*). Examination of Table 5-67 yields the following general observations for 1985:

Coal Production. The meet industry needs alternative and the state determination of leasing levels alternative show the greatest regional changes in coal production over the no new leasing (no action) alternative. The meet industry needs alternative indicates a greater emphasis on coal production from the western regions with corresponding reduction in production from eastern regions. The greatest production swings for this alternative are in the Green River-Hams Fork Coal Region and the Western Interior Coal Region.

- *Population.* Changes in coal-related population vary directly with coal production and consumption. The fact that population changes do not fully correspond to, and in some cases are the reverse of, coal production changes for certain alternatives in the Western Interior, Texas, and Uinta-Southwestern Utah Coal Regions indicates that for these regions coal consumption varies significantly. In other words, where population is shown to increase in Uinta-Southwestern Utah for a number of alternatives in 1985, despite decreases in production, increases in coal consumption (with resulting large increases in construction and operating personnel) are expected to occur. With these qualifications in mind, the table shows that the meet industry needs alternative and the state determination of leasing levels alternative provide the greatest coal-related population growth. Both alternatives show population increases in the western regions.
- *Land and Agriculture.* Land disturbance and agricultural productivity vary directly. Those residuals are in turn directly influenced by coal production and consumption activities. The table shows that whereas impacts on these two measures vary by region per alternative, the lease to satisfy industry needs and state determination of leasing level alternatives would result in the greatest impacts for the western regions. However, although the lease satisfy industry needs alternative indicates increased impacts for all western regions, the state determination of leasing levels alternative shows decreases in the Green River-Hams Fork and Powder River Coal Regions.
- *Water, Air and Operating Energy.* Changes in these impacts are not significant for the eastern regions. In the western regions, notably the Fort Union Coal Region, all alternatives show substantial impacts on water consumption, air degradation, and operating energy.

Examination of Table 5-68 yields the following general observations for 1990:

- *Coal Production.* Changes in production as a function of alternative are fairly uniform for the eastern regions, with some significant shifting in production (notable, between these regions for the satisfy industry needs and state determination alternatives). For the western regions, there is a shift to increased production in the Green River-Hams and Powder River Coal Regions, with decreases noted for the other western regions.

- *Population.* Population changes track coal production variations fairly consistently on an alternative basis as well as regional basis. Growth in coal-related population is seen to decrease generally in the eastern regions, and increase significantly in the Green River-Hams Fork and Powder River Coal Regions for the lease to satisfy industry needs and meet DOE production targets alternatives.
- *Land and Agriculture.* None of these impacts appears to be noteworthy in the eastern regions, except perhaps for the decreases in impacts indicated in the Texas Coal Region under the lease to satisfy industry needs and meet DOE production target alternatives. In the western regions, significant increases in impacts are shown for the Green River-Hams Fork and Powder River Coal Regions for the same two alternatives.
- *Water, Air, and Operating Energy.* Changes in these measures reflect a shift from eastern coal production and consumption to the West. In the West, significant increases in water consumption, air degradation, and operating energy use can be seen for the lease to satisfy industry needs and meet DOE production target alternatives in the Green River-Hams Fork and Powder River Coal Regions.

Many of the differences shown in the tables are small (less than 2 percent). The reader is cautioned about drawing any inferences from small differences since they fall within the accuracy of the assumptions used to generate impacts. Where the values are substantially in excess of a 2 percent change, the more secure are the inferences to be drawn from them.

5.4 IMPACTS RESULTING FROM SUBALTERNATIVES AMONG OTHER POLICY ISSUES

5.4.1 Introduction

Sections 5.1 through 5.3 of this statement discuss the impacts that could be expected to result from the adoption of the preferred Federal coal management program and the major alternative programs. The assumption underlying those sections is that different leasing strategies would cause different levels and distributions of coal production. All alternatives examined were designed to fully satisfy all requirements of existing Federal statutes.

A nationwide Federal coal management program is not, however, something that can be reduced to six or seven alternatives. At each stage in the process of managing Federal coal resources there are a variety of choices to be made—subalternatives concerning a particular issue—which usually are compatible with each of the major program alternatives previously discussed. Analysis of each combination of these various issue subalternatives would require analysis of thousands of alternatives. To make this task manageable and, more importantly, useful to decisionmakers and the public, analyzed in sections 5.4.2 to 5.4.9 of this statement are the subalternatives which, if adopted, could cause significant changes in the degree and distribution of environmental damage from coal development on Federal lands. In most instances, the issues and subalternatives discussed here are

those which the Department presented to the Secretary and Under Secretary as part of the process to designate the preferred program, and a fuller discussion of these issues is included in the papers presented to the Secretary and Under Secretary. (See Section 3.3 which describes these papers and explains how copies can be obtained.)

With respect to the methodological approach used previously in this chapter, the Department quantified, where possible, the adverse and beneficial changes to the environment that the adoption of the preferred program and each of the major alternatives would cause, and described the quantitative significance of these changes. This portion of the chapter will consider qualitative effects for the subalternatives. Unless noted otherwise, a principal assumption employed in the first method of evaluation is that the magnitude of impacts tends to be directly proportional to the amount of coal development. If this does not appear to be true, the analysis identifies discontinuities or unusual relationships. Wherever possible, repetition of material presented elsewhere in this statement is avoided and only information needed to understand the subalternatives and their impacts is presented. Accordingly, the discussion in the following sections should be read in conjunction with the material presented previously in this statement. For each issue and its set of subalternatives, the following factors are discussed, where relevant.

- What environmental elements are most likely to be affected by the subalternatives?
- Does the choice involved affect all regions equally, or is one region more affected than another?

5.4.2 Require Underground Mining

The first issue evaluated in the context of the various alternative coal management programs was consideration of the effect of limiting coal extraction on Federal leases to underground mining only. To implement this policy, two subalternatives could be adopted:

- Prohibit use of surface mining techniques on new Federal coal leases.
- Make no rule concerning mining method except as required by the Federal Coal Leasing Amendments Act of 1976 and the Surface Mining Control and Reclamation Act of 1977.

The western coal regions contain vast coal reserves of both underground and surface mineable coal. Despite the large underground reserve base, surface mining produces virtually all coal output in the Fort Union, Powder River and San Juan River Regions. Underground mining produces virtually all of the coal in the Uinta-Southwestern Utah Region. Surface mining accounts for approximately 30 to 60 percent of the production in the remaining regions. In 1976, an estimated 52 western underground coal mines produced 12 million tons and 61 western surface mines produced 97 million tons of coal. Table 5-69 presents projected percentage distributions of surface and underground mining under the preferred program. In general, coal produced by underground mining is more expensive and more capital and labor intensive than surface mining. Between 1950 and 1978, national coal production has gone from mostly underground to more than half surface mining. Industry efforts to reclaim lands disturbed by surface mining have also increased during this

period. The Surface Mining Control and Reclamation Act requires intensive regulation of both surface mining and the surface effects of underground mining. Under the permanent regulatory program of the Office of Surface Mining Reclamation and Enforcement no coal mining will be allowed unless the surface area disturbed can be reclaimed to pre-mining productivity and approximate original contour.

Several other factors distinguish these two mining methods. Deep mining is more hazardous to the miners than is surface mining, both in terms of fatalities and injuries. Mine safety is comprehensively regulated by the Coal Mine Health and Safety Act, 30 U.S.C. Chapter 22. Surface mining recovers a higher percentage of coal than does underground mining. The degree of recovery differs according to the area and type of mining involved. Typically, the recovery rates are 70 to 90 percent for surface mining versus 29 to 85 percent for underground mining. The Federal Coal Leasing Amendments Act bars the Secretary from approving a mining plan which does not use the method of mining which achieves the greatest recovery of coal. Where both surface and underground mineable coal exist on a given lease, the Secretary must require the lessee to use the method which recovers the greatest amounts of coal. Statutory changes may therefore be needed to carry out a deep-mine only policy, although the Office of the Solicitor has advised the Department that it may authorize "single-seam" leasing which would permit the leasing of only those seams which are recoverable by underground mining methods.

Surface mining usually causes greater surface disturbance, sedimentation, erosion, wildlife loss, and displacement of competing land uses and users than does underground mining. The degree of disturbance caused by surface mining itself varies greatly depending on seam thickness. Table 5-70 shows that acreage disturbed is directly related to seam thickness. Land disturbance from underground mining in the form of subsidence is a potential long-term problem, particularly in shallow underground mining.

Since new leasing would not result in significant production until 1985 at the earliest, adopting this policy would not cause any significant changes to the environment prior to that time. Assuming that a program is adopted which would resume leasing, a limitation to underground mining production from new Federal leases would affect the Fort Union, Powder River and San Juan River and Green River-Hams Fork Regions (those which have mostly surface mining); increases in production from new leases would be most likely in those regions where Federal coal is already produced by underground mining (Denver-Raton Mesa and Uinta Southwestern Utah Regions and in the nonfederal areas in the midwest and east). The potential effects on western coal production from a restriction to deep mining could vary from insignificant to critical, depending on whether actual production reaches the low, medium or high 1990 projections. Under the no new leasing mid-level projection, surface mining is expected to increase 50% in the six western regions, from 339 million tons in 1985 to 514 million tons in 1990. (Refer to the no new leasing alternative for an analysis of the maximum restraint on new Federal coal leasing—a policy of allowing underground mining only on new leases can be expected to approximate that alternative in those regions where

TABLE 5-69

PERCENTAGES OF UNDERGROUND AND SURFACE MINING FOR 1976, 1985, AND 1990 PREFERRED PROGRAM,
MEDIUM PRODUCTION PROJECTIONS

	1976		1985		1990	
	% Under	% Surface	% Under	% Surface	% Under	% Surface
Northern Appalachian	52	48	69	31	79	21
Central Appalachian	61	39	72	28	77	23
Southern Appalachian	36	64	52	48	65	35
Eastern Interior	40	60	68	32	84	16
Western Interior	3	97	38	62	62	38
Texas	0	100	0	100	0	100
TOTAL EAST	50	50	62	38	72	28
Powder River	0	100	0	100	0	100
Fort Union	0	100	0	100	0	100
Green River-Hams Fork	1	99	5	95	7	93
Denver-Raton Mesa	78	22	56	44	67	33
Uinta-Southwestern Utah	100	0	84	16	86	14
San Juan River	0	100	5	95	3	97
TOTAL WEST	13	87	9	91	8	92

TABLE 5-70

RELATION BETWEEN THE AVERAGE SEAM THICKNESS AND THE ACRES DISTURBED
BY REGION

Coal Region	Seam thickness (ft.)		Acres Disturbed/100,000 Tons ^a	
	Surface	Underground	Surface	Underground
Northern Appalachian	6	4	9.52	14.29
Central Appalachian	5	3	11.43	19.05
Southern Appalachian	5	3	11.43	19.05
Eastern Interior	6	6	9.52	9.52
Western Interior	3	3	19.05	19.05
Texas	8	-	7.14	-
San Juan River	8	6	7.14	9.52
Uinta-Southwestern Utah	11	8	5.19	7.14
Green River-Hams Fork	8	-	7.14	-
Powder River	26	-	2.20	-
Fort Union	12	-	4.76	-
Denver-Raton Mesa	4	7	14.29	8.16

^aDerived assuming 1,750 tons of coal/acre-ft. of seam, 100 percent recovery.

Source: Reference Number 71.

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underground mining is not economically competitive with surface mining.) Table 5-71 presents comparable estimates of residuals produced through mining coal by surface and underground methods in one region. The same kinds of transfer of impacts from unleased Federal lands to lands already under Federal leases and non-Federal lands described under the no leasing alternative would occur in the Fort Union, San Juan River and Powder River and Green River-Hams Fork Regions. These changes would not occur in the Uinta-Southwestern Utah Region or in areas of Colorado that are suitable for underground mining. Some interregional effects are also likely to take place with production being ultimately lowered in the surface mining regions and increased elsewhere.

A less likely, but still possible, effect is that a deep-mining only policy would affect neither the amount nor distribution of production to any great extent, but would merely alter the method of mining. Although the cost differences between surface and deep mining of between \$8 and \$15 per ton do not readily suggest this will occur, the possibility cannot be totally ruled out. The production cost difference could be reduced by a variety of changes in current conditions, including new technology and lowered Federal royalties and state severance taxes.

If this were to occur, it would be expected that the major effects of the deep-mining only policy would be to exacerbate social costs in mining areas since more employees would be needed. Per capita miner fatalities and disabling injuries would likely increase and less coal resource per acre would be recovered. A deep mine only policy would also require longer lead time and greater investments prior to production in order to assure that the specialized training needed to develop a work force capable of safe and productive underground mining is accomplished. Experience indicates that safety records may show dramatic improvement where regulatory enforcement, worker participation in decisions about safety requirements, or company economic interests provide incentive for better safety efforts. The deep-mining-only policy would also reduce adverse effects to wildlife, preserve existing surface environments, eliminate the risk of creating unreclaimed lands, and reduce total suspended particulates at or near the mine sites in the principal western regions where surface mining is predominant (Powder River, Fort Union, Green River-Hams Fork, and San Juan River Regions).

5.4.3 End Use Considerations

Inclusion of limitations in new Federal leases that constrain the end uses of coal produced from those leases was another issue addressed in the coal policy review. Four subalternatives were evaluated:

- Direct end-use considerations should be exercised during the leasing process to satisfy environmental goals and achieve energy policy objectives.
- End-use considerations should be allowed to enter the leasing process through special leasing opportunities afforded other departments and agencies.
- End-use considerations should not be part of a coal management program except as mandated by the Federal Coal Leasing Amendments Act of 1976 for "public bodies."

- End-use considerations should not be implemented pending an opinion by the Office of Solicitor on limits of the Secretary's authority.

Coal's principal use is electrical power generation. The environmental impacts associated with coal mining and power generation vary greatly depending on how and where the coal is consumed. The major categories are mine-mouth power generation (at or near the mine), or export (at or near the consuming area). United States), and foreign export (coal sent to Consumption of coal at or near the mine site in the West tends to increase certain adverse impacts of coal development. Coal consumption requires large amounts of water, a resource which is already scarce in most of the West, particularly in the Colorado River Basin and in the Powder River Basin. Also, the construction of power plants causes large numbers of workers to migrate temporarily to rural areas, which may lead to boom-town economic and social problems. In some instances, coal that is exported from a state may be used to replace mine mouth coal in the destination area causing loss of employment and tax revenue there.

The Department has not historically regulated the way from Federal coal leases is consumed (except for coal for railroad purposes under section 2(c) of the Mineral Leasing Act of 1920, 30 U.S.C. 202), but section 2 of the Federal Coal Leasing Amendments Act of 1976 (30 U.S.C. 201(a)) now requires it to do so for "public bodies." The Solicitor is determining whether the Department has legal authority to regulate end-use for purposes other than use by public bodies and railroads.

The Department of the Interior is not the only agency which might have a role in deciding how coal is to be used. The Federal Energy Regulatory Commission and state public service commissions or siting agencies exercise considerable authority over the location of new power plants. The Interstate Commerce Commission's approval is also necessary for rail lines and rates. Also, Section 125 of the Clear Air Act establishes a process whereby utilities can be barred from using other than local coal. Proceedings to invoke this clause have begun in Ohio and in Illinois.

Assuming that new leasing takes place, virtually every aspect of the environment could be affected by the first subalternative (application of end-use stipulations in leases).

The subalternative of controlling end-uses through lease terms would not, however, necessarily lead to a single policy objective. The following, sometimes mutually exclusive or conflicting controls could either be adopted as a general rule, or be applied in particular instances, possibly at the request of a state governor. To prevent replacement of eastern and mid-western coal by western coal, a lease stipulation could prohibit a company from shipping the coal more than a specified distance or from selling it to be burned in certain states. If other western coal were not available to substitute for the use restricted coal, this subalternative would lower western production and reduce environmental impacts in the western regions. Most likely to be affected by this subalternative are the Powder River and Green River-Hams Fork Regions which are the principal western sources of export coal to eastern and midwestern markets. Lesser effects would occur in the Uinta-Southwestern Utah Region which now supplies some coal to plants in states such as Ohio and Indiana and in the San Juan River Region which supplies coal to Texas. As the high

TABLE 5-71

ANNUAL ENVIRONMENTAL RESIDUALS ASSOCIATED WITH 10 MILLION
TONS OF COAL SURFACE MINED OR UNDERGROUND MINED IN THE
UINTA-SOUTHWESTERN UTAH REGION^(a)

		Underground Mining	Surface Mining	
Land Disturbed (acres)	Short Term	0	520	
Water Make-Up (acre-ft.)	Evaporative	184	551	
	Effluent	184	56	
Air Emissions (Tons)	HC	0	45	
	CO	0	234	
	SO _x	0	30	
	NO _x	0	385	
	TSP	0	40	
Population - Total		12,497	4,699	
EMPLOYMENT	Construction	Direct	480	321
		Indirect	672	449
	Operation	Direct	1,970	600
		Indirect	2,758	839
Accidents		312	5.3	
Fatalities		4	1.1	

^a Derived from the U.S. Department of the Interior Coal Impact
Estimation Program (see Appendix H).

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moisture content of the lignite reserves of the Fort Union Region limits that coal's usefulness for export, that Region would be relatively unaffected. This subalternative could have impacts in the eastern and midwestern regions if it causes production increases in those regions. Employment and environmental impacts would increase. Finally, it could also cause a shift in how western coal is transported to other markets. The subalternative only involves shipment of the coal. It could cause companies to mine and burn the coal in the West and transmit the power to eastern and midwestern markets. Because of the energy loss in power transmission more coal production would be needed to produce the same amount of electricity to consumers move. through transmission lines. It might also create new markets for coal gasification and liquefaction.

To minimize use of water, reduce coal-related population increases, and protect air quality in the producing regions, a lease stipulation could prohibit the consumption of the coal from a Federal lease in, for example, the state where it is mined unless a specified percentage of the power would be used by customers in that state. Again, assuming that this subalternative is effective and that it changes the locus of power production facilities, adoption of this stipulation would retain water for agriculture, grazing, wildlife and other competing industrial uses to a larger extent than would the absence of any end use controls. It would also hold down population increases in areas with small baseline populations and would relieve concomitant adverse social and economic impacts, including those on housing, law enforcement, schools, sewage treatment, and the like.

If the lease stipulation applies to coal shipped to the West, as well as to the East, it could affect rather severely power production plans in Washington, Oregon, and, to some extent, California as only western coal is a reasonable, cost-effective source of supply for these states.

The subalternative would also shift pollution and water use problems associated with coal conversion closer to areas where electricity would be used, and would require more costly long distance transportation. On the other hand, it would reduce the adverse environmental impacts which result from extensive power transmission lines through sparsely populated areas. It trades savings of social impacts, water use, and loss of power from transmission lines for impacts associated with rail transportation.

It is difficult to forecast with any reasonable precision how significantly the Department could affect utility plans to site power plants on the basis of stipulations in new leases. Depending on a variety of other factors, the actual change in power production patterns could be insignificant. The Department's ability to carry out these policies independently of other agencies varies from region to region. It is the highest in the Uinta-Southwestern Utah Region because of very high Federal ownership of the coal resource and the land over which powerlines must be located (to remedy the lack of an adequate existing rail transportation and power transmission infrastructure). To a similar but lesser degree, the same conditions prevail in the San Juan River Region. The Department has less control through this subalternative in the Fort Union, Powder River, Green River-Hams Fork and Denver-Raton Mesa Region because the Federal share of both the coal and surface resources is less.

The Department could also decide to combine the previously discussed lease stipulations and prohibit both long distance rail transportation and mine-mouth power generation for out-of-state consumption. The combined alternative would be the most restrictive approach possible and, if applied to *all* new Federal leases, would greatly limit new leasing.

Cooperative efforts to optimize power plant siting decisions offer a less direct, but potentially equally effective way to deal with power plant siting problems. For example, Utah is rich in relatively high Btu, low sulphur underground coal that can often be mined with a comparatively small amount of environmental disturbance. It is equally rich in recreational resources, including a variety of national parks and wilderness areas. Utah is receptive to industrial development and employment opportunities if they can occur without undue adverse environmental changes. How to transport and burn this highly desirable coal resource without destroying the natural features of the State is a highly complex problem. The Department of the Interior and the State of Utah have been closely cooperating to find appropriate sites for plants that will minimize employment, air and water problems. A decision not to adopt the first end-use subalternative is not, therefore, a commitment to unrestricted, deleterious coal development. Formal and informal cooperative efforts can accomplish many of the same results.

To encourage development of new technology either for DOE projects under section 908 of the DOE Act, or for privately financed projects, a lease stipulation could require the coal in the lease to be developed by a particular mining method (such as in-situ gasification) to protect lands that offer high potential for a new technology.

Although the Department has not made a detailed investigation of lands potentially suitable for new technologies, there may be lands that can be mined not only by conventional methods but also by new mining techniques including in-situ gasification or hydraulic mining of steeply pitched coal seams, because of either economic or environmental conditions. Unless a lease stipulation requires a particular form of development, the opportunity to use such techniques could be lost. of this subalternative are, like many of the technologies it may foster, largely speculative.

Controlling end-use as a consistent policy would cause very fundamental changes in how the Department leases coal. The Department does not now "package" its coal leases for any particular buyer or purpose. It offers the coal and whoever bids highest receives the lease. Consider a lease sale for a tract in Wyoming, for example. One bidder may want to mine the coal to sell it for power generation in the same state. Another bidder may prefer to export the coal to Texas. Other bidders may have buyers in Minnesota and Illinois. As it is often difficult for a mining company to sell coal before it has the right to develop it, still other bidders may not have any customer under contract, but will want to obtain reserves to begin negotiations for customers. As a result of this, under the current policy, the Department's main role is to examine the impacts of coal development at or near the mine site and, for analytical purposes only, to hypothesize where and how the coal might be consumed. This market-oriented system is compatible with the competitive bidding aspects of the Federal Coal Leasing Amendments Act of 1976.

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An end-use control policy could change this. In the extreme case, the Department would match a particular parcel of land with a particular project. The moving force for coal lease sales would be the companies that would use the coal, not the company that would mine it. The Department would attempt to assist the user company to put together all the factors — obtaining a source of water, gaining access rights, acquisition of surface owner consent, ensuring availability of transportation — necessary to bid for and develop a lease. This would, of course, eliminate much of the uncertainty which exists in a competitive bidding system, would allow the Department to be confident that the coal it leases would be developed, and would ensure that the environmental effects of the entire cycle would be scrutinized. It would also require the Department to acquire planning capability on a scale far in excess of its present capability. Substitution of federal authority and decision-making for choices and plans now made by industry and by State and local governments would be a substantial change in traditional federal responsibility. The consequences of such an increased Federal role would likely be more significant to political and economic relationships in our society than to the environmental values and standards which are within the scope of this statement.

5.44 Concentration of Federal Leases

In the past, the Department has made little, if any, effort to examine current production patterns prior to leasing, even though decisions about the distribution of production within a region can influence overall effects almost as much as decisions on quantities of production. Similarly, no state or region has had an effective government planning organization that has long-range plans to optimize location of new mines, although some states have recently passed siting laws for mining activities on private lands. Although coal companies have obtained coal development rights, including Federal leases in a wide variety of areas throughout the West, primarily because of economic considerations (including those related to coal resource quality and transportation availability), western coal development has tended to concentrate in a few areas. Development is now concentrated in the Colstrip and Decker areas in Montana, in the Gillette to Douglas corridor in eastern Wyoming, in south central and southwest Wyoming, in Emery and Carbon Counties in Utah, near Farmington in New Mexico, and near Craig and Delta in Colorado.

In addition, because of the new requirements of Federal laws, the Department must have a reasonably high degree of data collected, rehabilitation considered, and land-use planning done before it can lease. One consequence of the existing development pattern is that the needed information tends to be most complete and accurate in areas where development has taken place in the past, so the Department is better prepared to lease in those areas without requiring new data to be gathered and analyzed. Another set of subalternatives concerns the limitation of new leasing to areas already producing coal. Specific subalternatives which could achieve such concentration include:

- Adopt a preference prior to planning that: (1) new leases be issued only near existing production

(concentration); and (2) new leases be issued in areas apart from existing production (dispersal).

- Adopt no preference but take these factors into consideration in the tract selection process.

The principal benefits that could occur in terms of the major areas of environmental consideration are associated with the socioeconomic aspects of a particular area rather than the physical or biological aspects. Concentrated development could allow for centralization of requisite planning efforts within a single county or small number of counties in a region. This could in turn allow for uniformity in regional planning that would not necessarily occur with random dispersion of development. Planning efforts could be directed toward a new community or the expansion of an existing community which would be the focal point of support for the concentrated development. Housing and community services would be centralized and could potentially benefit from the economies of scale of a single larger community as opposed to a scattering of smaller communities. Services such as schools, police and fire protection, and waste handling could potentially be provided at a greater level of efficiency and effectiveness through centralization of efforts. Beyond certain levels, however, the effects of concentration could bring significant disadvantages to a community as discussed in sections 5.2, 4 and 6.3 of this statement.

Development in existing areas will be accelerated if new leasing is needed and current nonproducing areas are not available for development. Concentrating leasing could eliminate the need for, and perhaps the economic viability of, new transportation systems. Assuming the policy is coupled with new leasing of any magnitude, it could worsen problems in some areas which have been experiencing recent rapid development. In other areas, concentrated development could take advantage of, and even provide economic reinforcement to, those public and private investments that have been made to accommodate demands caused by initial coal developments.

The effects of development concentration on the physical and biological facets of environmental resources would depend on specific circumstances. The amount of land disturbed within a region as a result of adopting the concentrated development subalternative would generally be less because transportation and other supporting or ancillary facilities would tend to be fewer. Rail lines, haul roads, power lines, borrow pits, and other facilities could serve multiple mines. Concentrated development, however, could produce levels of impacts which could seriously affect air or water quality or could add significantly to the water demand within a local area. The levels of air pollutants associated with concentrated development could lead to the violation of air quality standards within a region. This has been the case in the Colstrip area of Montana where concentrated development has produced particulate levels that exceed national primary air quality standards. Similarly, potential water pollutants would more likely be directed toward a single water system with concentrated development, thereby increasing the probability of producing significant adverse impacts on water quality or requiring significant treatment costs. The increase in water demand associated with such development could potentially exceed the development area's supply or could preempt other development within the area due to the water requirements of concentrated development. The potential for

effects on biological resources is basically dependent on habitat disturbance and the amount or area of such disturbance would be approximately the same with concentrated development as with dispersed development. In areas lacking an established rail transportation network, a scattered development policy may actually preclude development of coal resources for other than mine-mouth conversion. Major rail extensions typically cost in excess of \$1 million a mile to build []. Revenues generated from transporting coal from a single, moderately-sized mine may be insufficient to amortize the extensive cost of a major rail extension. Should the extension be financed by a coal company rather than a rail common carrier, the added expense may make the coal uneconomical to a distant electric utility or other consumer.

The advantages and disadvantages of this subalternative are somewhat subjective. While the issue has been extensively discussed outside the Department, (see for example reference 88), its resolution is unclear.

5.4.5 Due Diligence

Diligent development and continuous operation regulations discourage companies from failing to develop Federal coal leases, minimize inefficiency and wasted effort in planning for coal leasing and production, and help ensure that the government will receive fair market value for leases. In the past, the Department included in leases minimal diligence and continuous operations requirements but did not exercise stringent enforcement. As a result of this policy and economic conditions affecting western coal development and other factors, until very recently the vast majority of Federal coal leases have not produced any coal at all.

The Congress; in 1976, strongly affirmed that diligence is to be a major factor in any Federal coal management program by mandating the strict application of diligence standards.

In 1976, the Department adopted new diligent development and continuous operation-regulations which require all existing leases to produce at least 21/2 percent of the lease reserves by 1986 (with an extension possible for an additional five years under limited circumstances). New leases are required to produce 1 percent of the deposits within 10 years after lease issuance. By statute, a company that receives a new lease must also submit a mining plan within three years from lease issuance. Since those regulations were enacted, there has been significant movement toward activity on these leases (see section 2.7 which describes likely production from existing leases).

The Department considered several due diligence subalternatives; however, it no longer has the authority to revise diligent development and continuous operation regulations. The Congress transferred that authority to the Department of Energy in the Department of Energy Organization Act.

The specific due diligence subalternatives considered by the Department include:

- Continue existing standard of producing 1 percent of reserves by the end of the first 10 years, a minimum of 1 percent each year thereafter, and total exhaustion of all reserves in 40 years after a mine plan is approved.
- Raise or lower initial ten year production period.

- Raise or lower total 40 year production time.

Major coal mines in the West require at least three years after lease issuance to be in production under the best of circumstances; five to seven years is not unusual. Any effort to reduce diligence below these timeframes would create management problems which could frustrate a situation totally unrelated to the purpose of diligence. In addition, coal companies, like other mining companies, have some need to maintain an "inventory" of uncommitted coal reserve's. This inventory serves as protection against rising resource costs and gives the companies assurance that they have the resources to enter markets as they develop. To some extent, the long-term coal market, particularly in times of high demand, dictates that a supplier has assured reserves before a customer will commit itself to a binding contract.

The effect of different diligence standards could make short period for initial development an impediment to effective planning and community capital construction. A significant shortening of the initial diligence period (say to 5 years) would probably make it very difficult for many operations to commence. Companies may only have time to do initial site preparation before the lease would terminate. This would cause the companies to lay-off the initial work force, and preparation for development, such as new roads, housing, school construction, sewage facilities, etc., would be wasted. If the time period were too short, the risk of development might be so great as to discourage otherwise reasonable development.

A significant lengthening of the time for initial production (say to 20 years) would ensure that all planned production would have adequate time to take place in an orderly fashion. If all production tended to be initiated toward the end of this extended period, it could also facilitate community planning by increasing the time from lease issuance to land disturbance. In this longer time period, more capital construction could take place, workers could be trained, and similar pre-mining activity could commence. There is no guarantee, however, that this would actually happen, and, in fact, all production might still occur within 10 years of lease issuance.

A significant increase in the continuous operation rates (i.e., to require total extraction in 25 years) would have two tendencies: either the production rate from each lease would tend to be increased, thereby lowering the total number of producing leases and concentrating the effects of development in a smaller area (i.e., a 100 million ton deposit would be mined at a 4 million ton per year rate instead of a 2.5 million ton per year rate); or the total number of mines would remain the same, but the period of mining would be shortened by 15 years. The Department can control which alternative results through its tract selection policies. In the foregoing example, if the Department wished to see accelerated development on a single lease, it would lease to set up a logical mining unit of 100 million tons; for a lower rate of development, it would lease to set up a logical mining unit of 62.5 million tons. If the 40-year period were reduced to 25 year period of coal development, this would reduce the number of years for which a commitment to development was made. With this more limited commitment, the Department could reevaluate whether, at an earlier time, it wished to continue the pattern of development. It would give the Department greater ability to

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respond to changes in demand for Federal coal. The impacts of this earlier reevaluation (25 years rather than 40 years after lease issuance) are entirely speculative at this time. Policies of periodic leasing tend to diminish any benefits. If the subalternatives were carried out to change the yearly development rate, environmental impacts on a particular parcel of land would be concentrated. More acres would be disturbed on the leasehold in any particular year. This might increase problems for effective wildlife management, dust control, rehabilitation, erosion, and sediment loading in streams. On the other hand if few leases were needed, the adverse effects of dispersed leasing might be lessened.

The effects of these possible changes in the diligence policy will be most clearly felt in the regions most likely to require more leasing: Powder River, Green River-Hams Fork, and San Juan River.

5.4.6 Land Ownership Patterns

Land ownership is very complicated in the West. Vast amounts of land are owned by private, state, Indian and Federal interests. For approximately six million acres, the surface estate is privately owned and the mineral estate is Federally owned. Table 2-5 summarizes ownership figures in western KRCRAs.

Because of railroad grants, large amounts of land, including land which is valuable for coal, is held in checkerboard patterns, with alternate sections held by the United States and private owners.

This checkerboard pattern is most prevalent in the Fort Union and Green River-Hams Fork Regions and in the northern portion of the Powder River Region. Small checkerboard areas also exist in the San Juan River Region. It has been estimated that over 300,000 acres of the privately owned portion of the checkerboarded lands have been committed for coal development.

In a very large number of townships in the West, states own sections 16 and 36. The United States transferred this land under the school land grant programs established in the Statehood Acts. Both the checkerboard patterns and the school land patterns are in 640-acre units. Coal in these areas, however, can rarely be mined in contiguous areas of less than 2000 acres. Consequently, areas with these ownership patterns cannot be mined efficiently, if at all, without approval from more than one entity.

The Congress in section 714 of the Surface Mining Control and Reclamation Act of 1977 has given a limited number of farmers and ranchers who own land over Federal coal veto power over leasing for surface mining if they meet certain qualifications and have not previously consented to surface mining. (see sections 1.3 and 3.3) Land owned by persons who do not meet the standard in section 174 may be leased without the owner's consent if a bond is posted to cover the cost of damages to crops and improvements, among other things in accordance with the law under which the United States sold the surface estate (see section 3.).

The various owners of tracts in checkerboard areas have not only direct but also indirect veto power over coal development by their ability to affect access, water rights and other elements needed to develop a coal lease. The control or ownership of adjacent, privately owned properties is also

important because it often gives the controlling company some advantage in the competitive coal lease sale. The advantage stems from the dual factors of better resource knowledge, coupled with the certainty of cooperation from the surface owner. This problem is minimized where the mineral owner is willing to share resource information with others.

Leasing decisions based on surface ownership patterns could produce significant variations in environmental impacts. Specific subalternatives considered in this context include:

- Do not take surface ownership into consideration when leasing except as required by the Surface Mining Control and Reclamation Act.
- Do not lease unless Federal Government owns both the coal and the surface estate.
- Do not lease in "checkerboard" areas.

The subalternative of not leasing unless the Federal Government owns both the coal and the surface estate would not be likely to change significantly development patterns in either the Uinta-Southwestern Utah or San Juan River Regions since approximately 85 percent of all coal in KRCRA's in those regions is overlain by Federal surface. The subalternative has the potential for significant change in the Green River-Hams Fork Region since over 60 percent of the coal there is privately owned. The subalternative would have its greatest effect in the Fort Union Region, where 99.8 percent of all Federally-owned acreage in North Dakota and 87 percent in Montana is overlain by private surface. The Powder River Region would be similarly restricted.

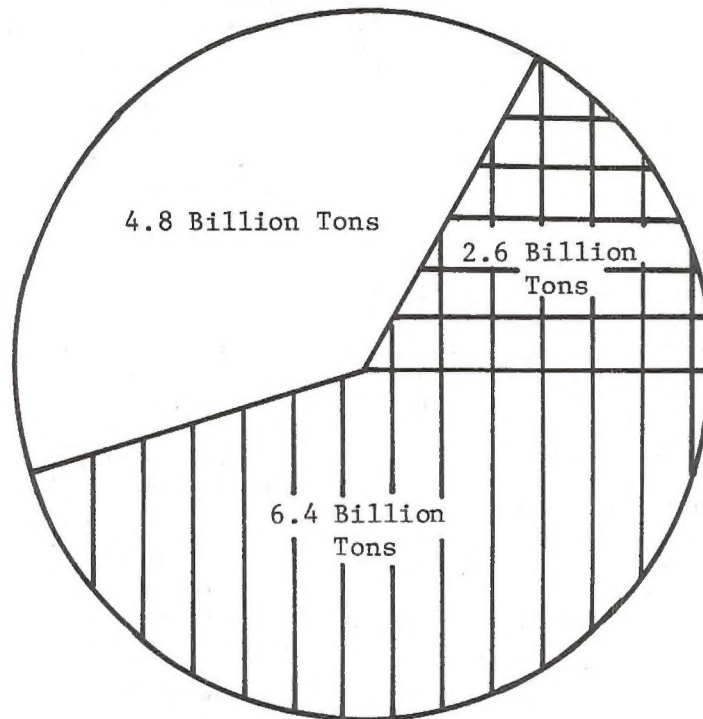
If new coal leasing is needed to meet demand in these regions with significant split estate land patterns, this subalternative could limit the ability of the government to meet this need. The Department specifically studied this question in two areas. (It should be emphasized that these studies did not measure the impact of providing surface owner consent to that limited number of ranchers and farmers protected under section 714 of the Surface Mining Control and Reclamation Act, but dealt instead with the much broader question of foregoing leasing under all non-Federal surface.) For southern Campbell County, Wyoming, this subalternative would eliminate from consideration for leasing over 11 billion tons of Federally-owned coal leaving only 2.6 billion tons available. These 2.6 billion could be further reduced by the application of unsuitability criteria or other environmental restrictions. Figure 5-7 indicates the maximum yearly production rate assuming a forty-year mine life and annual production of 5 million tons a year, from this reserve would be limited to 51 million tons per year. To the extent this is not sufficient to meet the demand, production above that level would either be transferred to existing Federal leases or to private lands, either within or outside the region. Since the coal in this area has the thickest coal seams of any coal in the United States and a well-developed transportation network of any coal in the United States (including privately-owned coal within the Powder River Region), the net effect of this policy could be to increase the total acres of land disturbed by mining and to create pressure for construction of new coal transportation networks elsewhere in the West.

The Department also estimated that this subalternative could constrain development in the Decker-Birney Planning Unit in Montana in the northern part of the Powder River

FIGURE 5-7

RESERVES CLASSED BY
SURFACE OWNERSHIP STATUS: SOUTHERN CAMPBELL COUNTY

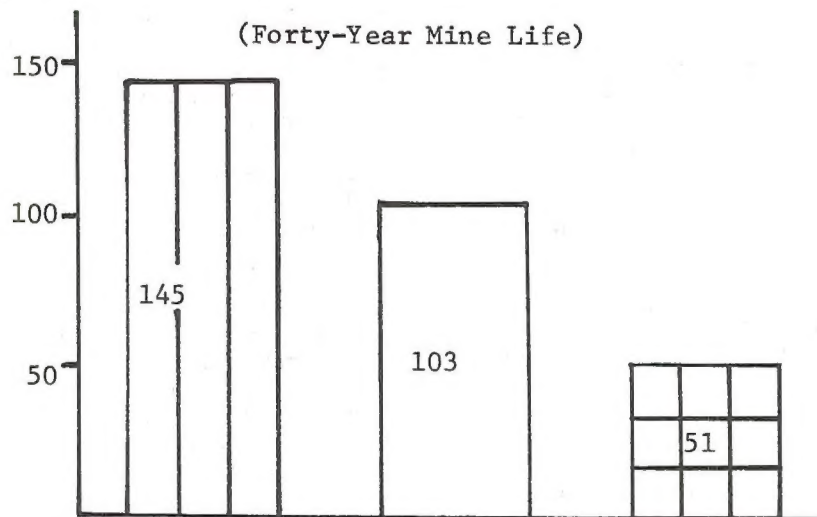
(Unleased Federal Coal)



13.8 Billion Tons Total

MAXIMUM ANNUAL PRODUCTION POTENTIAL: CONTIGUOUS BLOCKS
OF 100 MILLION TONS OR MORE

(Forty-Year Mine Life)



Federal
Coal -
Private
Surface



Federal
Coal -
Federal
Surface



Federal
Coal -
Coal Company
Surface

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Region. Again, as in the Campbell County Wyoming area, the Decker-Birney Unit has vast coal reserves, and, in parts, a developed rail system. It is the site of ongoing coal development. As part of the Department's task force on developing land unsuitability criteria, a field test was done in the Decker-Birney Unit to determine how much coal would be available for leasing. Figures 5-8 and 5-9 present estimates of the amount of Federally-owned strippable coal deposits in the Decker-Birney Planning Unit. Lands potentially available for lease were identified after applying the most stringent of the alternative suitability standards (including some which the Department later modified to be less stringent) in two ways: (1) without regard to surface ownership and (2) excluding all coal underlying non-Federal surface. Under first set of assumptions, the eight deposits of 400 million tons or more, two deposits of 150 to 400 million tons, and nine deposits of 20 to 150 million tons were identified as potentially available for leasing. Under the second set of assumptions, only one deposit of 400 million tons, none from 150 to 400 million tons, and eight from 20 to 150 million tons remained. As in the Campbell County, Wyoming example, the amount of land available for coal leasing would be significantly reduced under this subalternative.

The work done in these two areas appears to be transferrable to areas with similar surface ownership characteristics. The studies did not attempt to make any specific findings whether the overall impacts of developing the Federal surface versus private surface lands were significantly different in these areas.

The exact effect of shifting leasing to land where both the coal and the surface estate are Federally owned compared to land with Federal coal and private surface or private surface and private coal is unclear. Totally private surface and mineral estates, particularly in Wyoming and Montana, tend to concentrate in river and stream valleys and along major highways as compared to estates having whole or partial Federal interests. Similarly private surface estates overlying Federal coal tend to be in these same areas as compared to Federal surface. Except for areas such as southern Campbell County, Wyoming, Federal surface lands with both and Federal coal would then tend to be in areas further from existing transportation, in rougher topography, less intensively used, not in alluvial valleys or flood plains, and the like. Private lands, including railroad lands also tend to be closer to towns and roads. Development in all Federal areas would tend to increase the need for new infrastructures. Information on these issues available in several recent coal studies. In the long run, this subalternative would also tend to distribute coal development more extensively in areas where the land and coal are entirely Federally owned. The social and economic consequence of a subalternative that prohibits leasing under non-Federal surface would be substantial. Such a subalternative would not give significant additional protection to those ranchers and farmers whose property rights are already safeguarded under the Surface Mining Control and Reclamation Act, and would eliminate the prospect of cooperation by any non-Federal landowners, including those protected under that Act and all others who are willing to assist in the development of Federal coal under their lands. In some areas, coal production would not be possible, and those residents who anticipate increased employment opportunities

and the other economic changes associated with coal development would not experience such changes.

In other areas, mining on Federal surface could cause social and economic changes that would be experienced by all residents, and the ban on mining of private surface would simply deny some landowners the opportunity to participate in personal economic benefits from Federal coal development in their area.

A less extreme version of this policy, to allow leasing if the surface were owned by a coal company or a party who did not farm or manage the land for grazing would nearly double southern Campbell County, Wyoming lands available for leasing. This dramatic increase in land availability might not occur in other areas of significant private ownership since coal companies and investors have long recognized Campbell County as a prime coal area. The Department does not have accurate figures at this time for other areas, but they may be available for the Decker-Birney area before the final statement is prepared. Purchases and other ways to control the surface are likely to be more prevalent here than in other parts of the West.

The subalternative of not leasing in checkerboard areas presents similar problems. The principal effect of this subalternative would be to forestall development of the coal lands in both the Federal and non-Federal portions of the checkerboard areas where the federal coal is now unleased. Department estimates indicate that 42 percent of the total coal reserves (Federal and non-Federal) in the Fort Union Region, 16 percent in the Powder River Region, and 27 percent in the Green River-Hams Fork Region would likely be incapable of development without Federal leasing. Other regions have few or no checkerboard areas and would not be changed by this subalternative. The subalternative would eliminate mining in checkerboard areas as relatively little Federal coal has been leased in those areas. Some coal in checkerboard areas may be developed in conjunction with state lands but, in general, mining of coal in the checkerboard areas would be greatly limited. With the exception of the Fort Union Region and possibly in the Wyoming portion of the Green River-Hams Fork Region, there is probably sufficient coal in non-checkerboard areas to meet foreseeable coal needs from Federal reserves and non-checkerboard private reserves.

The environmental effects of this subalternative are difficult to estimate. The checkerboard areas tend to have better transportation access to rail lines than non-checkerboard areas. The effect of this subalternative may be increased environmental disturbance to build new transportation facilities. Similarly, vegetation distribution and wildlife habitats may vary from checkerboard areas to non-checkerboard areas. The overall environmental impact on these lands as compared to Federal surface or other private surface is not clear.

The adoption of this subalternative would also have competitive implications. The Justice Department has recommended that the Department of the Interior proceed to ensure that the railroads' control of these lands will not have anticompetitive effects.

Failure to adopt either of the subalternatives on a program-wide basis would not foreclose the Department from adopting them on either a regional or lease-by-lease basis. The land ownership could, for example, be a factor in tract

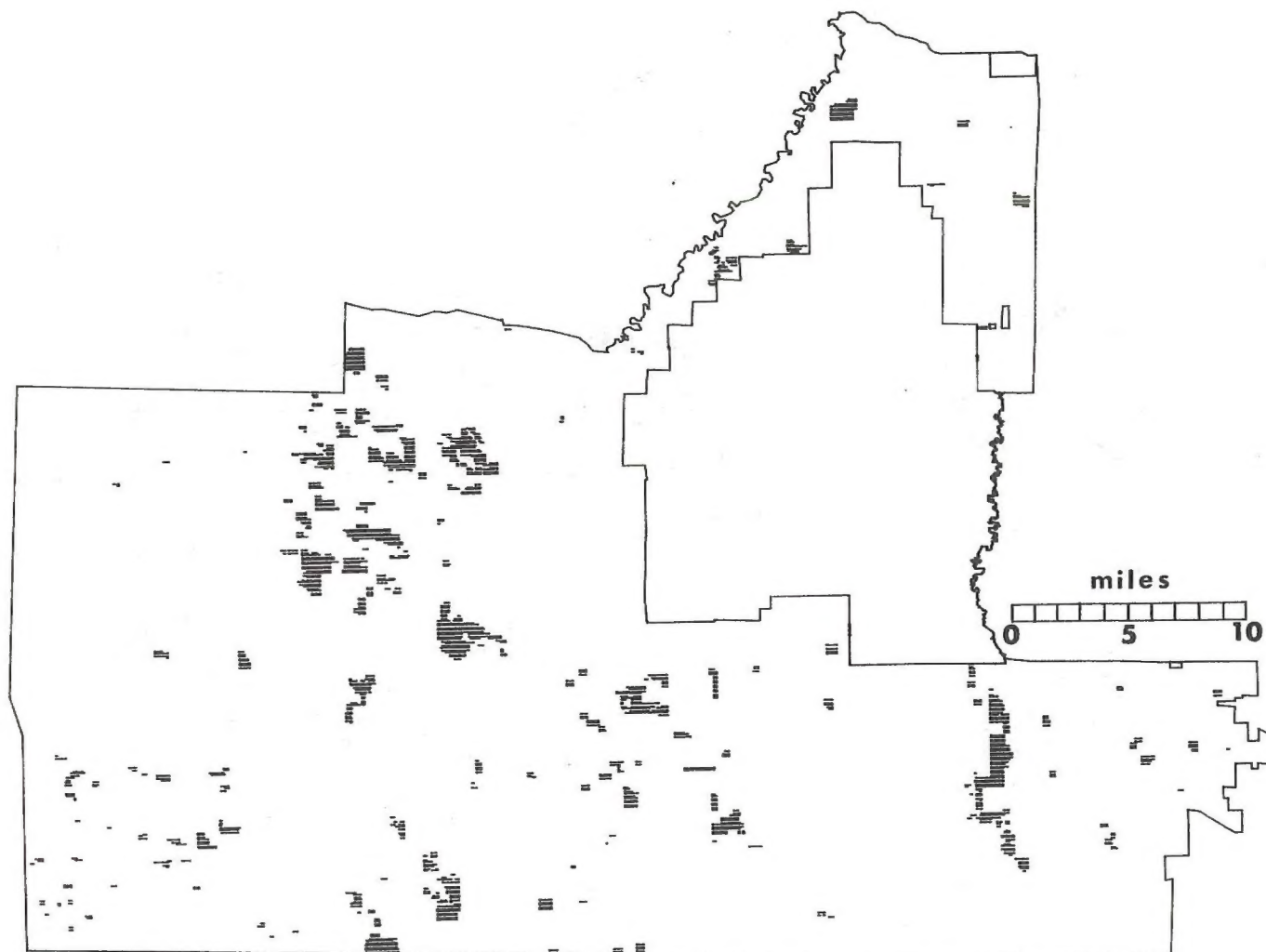


FIGURE 5-8

FEDERAL STRIPPABLE COAL DEPOSITS: DECKER BIRNEY PLANNING UNIT
ALL TESTED SUITABILITY CRITERIA INCLUDING SURFACE OWNERSHIP

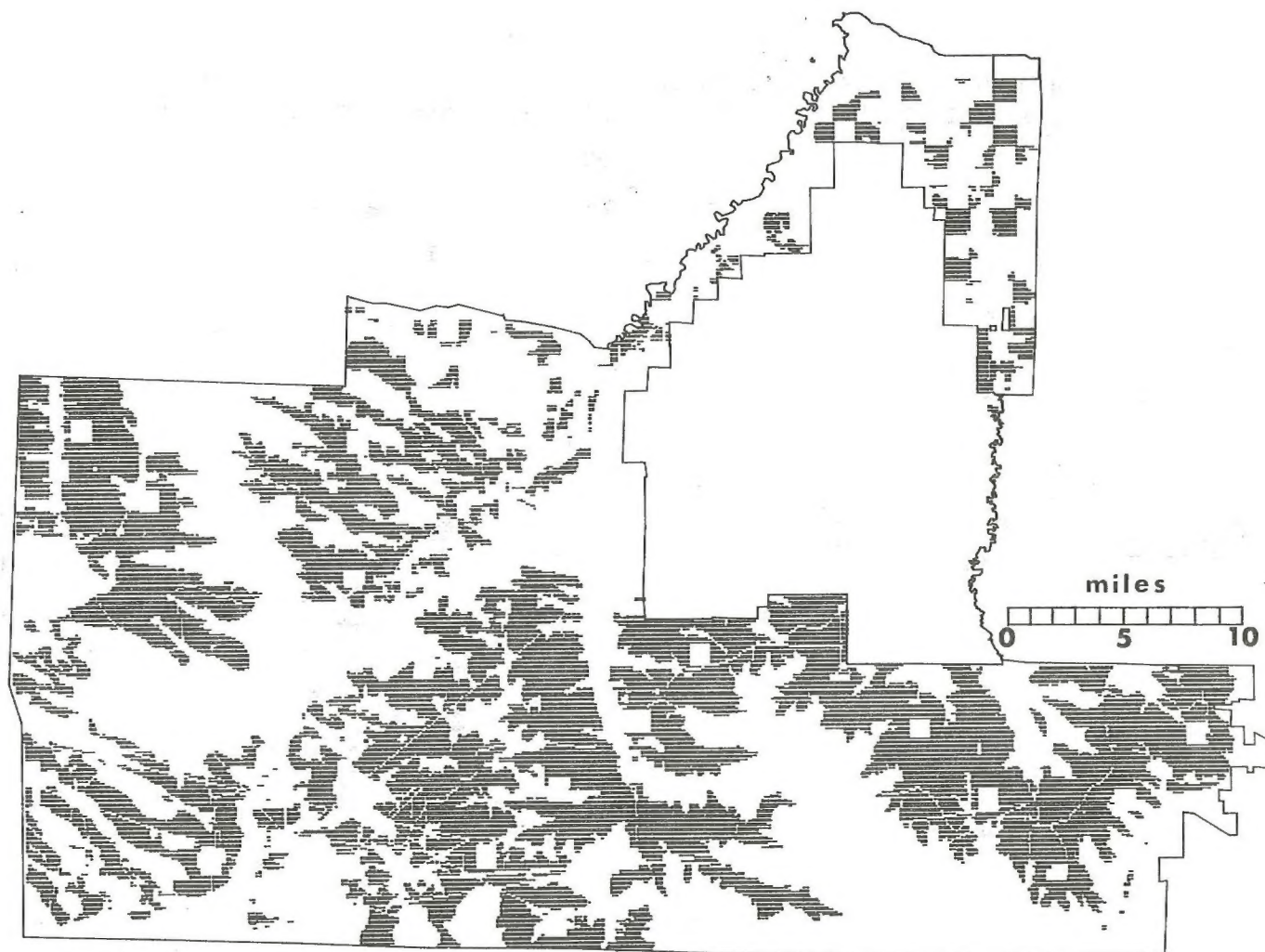


FIGURE 5-9
FEDERAL STRIPPABLE COAL RIGHTS: DECKER BIRNEY PLANNING UNIT
ALL TESTED SUITABILITY CRITERIA EXCEPT SURFACE OWNERSHIP

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ranking. Both the land use planning process and the tract delineation and ranking process in the preferred program will give the Department the opportunity to compare the environmental impacts of developing lands with different surface owners.

5.4.7 Maximum Economic Recovery.

Prior to the enactment of the Federal Coal Leasing Amendments Act of 1976, the Department did not have either a statutory mandate or extensive formal guidelines or regulations to assure that coal reserves would not be lost as part of a mining operation, particularly for surface mining operations. The Geological Survey has enforced standard principles of resource conservation as part of its oversight responsibilities on Federal coal leases. Congress, in the 1976 Act, added two specific requirements to improve coal resource recovery. First, prior to issuance of a lease, the Secretary is directed to consider and compare which method or methods of mining will result in the "maximum economic recovery of the coal in the proposed lease tract." This determination is not binding upon the Secretary. Second, the Secretary is prohibited from approving a mining plan which does not achieve the maximum economic recovery of the coal in the leased tract. Congress' goals in enacting this provision were to prevent waste of coal resources and to minimize environmental damage from mining by assuring that all economically recoverable coal would be mined so that a second mining operation at some later date would not be necessary. Three subalternatives concerning Maximum Economic Recovery (MER) have been considered:

- MER is evaluated seam-by-seam. (The lessee must mine and recover coal from each profitable seam.)
- MER is evaluated on all seams. (The lessee must mine and recover coal from all seams which are collectively profitable excluding seams technically or environmentally unrecoverable.)
- MER is limited to a decision only on what mining method or methods are to be used and the decision on which seams are to be mined and recovered is one based on sound resource conservation principles.

The subalternative the Department chooses will affect recovery in both surface and underground mines. In surface mining, it will affect the stripping ratio to which a company will have to mine: companies will be required to recover coal under greater depths of overburden. In underground mines, it may affect the number of seams to be mined, the equipment to be used, the depth of mining, and the amount of coal in each seam that is mined. In all instances, the most likely effect of a decision to apply a strict MER standard is to prolong existing mining operations or increase yearly production rates of those operations, or a combination of the two. This should, to some extent, increase the production from mines and diminish the need to open other mines.

The first two subalternatives considered for MER, which involve the economics of an operation, impose additional government administrative costs and inject the government more deeply into the mining process than was true in the past. The more stringently the Federal Government defines MER, the less value it will receive for leases offered by a competitive bonus system since the increased cost of mining the last, more

costly unit of coal lowers the economic rent to the government. Costs to consumers could tend to increase as lower grade (more costly) coal is recovered.

In addition to potential reductions in the lease bonus payments by mining companies, there are several other potential impacts that could result from strict interpretation of the MER authority. These impacts include:

- Shifts from Federal coal to non-Federal coal.
- Increased levels of severance tax revenues.
- Possible reductions in acreage disturbed.

There is the possibility that the rigorous application of the first two MER subalternatives would diminish the competitiveness of Federal coal leases as compared to non-Federal lands. To the extent that is true, it would reduce production from Federal lands, and cause production shifts to state and private lands.

Any shifts from Federal coal lands to non-Federal coal lands would result in decreased bonus payments to the Federal Government. As production commences, however, there will be increased levels of severance tax revenues to the state governments.

Acreage disturbed by mining may be reduced through a strict interpretation of the MER authority. This could occur as a result of surface mining and subsequent deep mining of specific tracts. In this fashion previously foregone coal resources would be extracted and less land disturbed per tonnage mined.

The first two MER subalternatives might also prevent certain lands from being developed for gasification or other in-situ processes if these methods were not the method that achieved the maximum economic recovery of the coal resource. This would both reduce the potential supply of natural gas and change the environmental impacts of the mine site from those associated with a gasification plant to those associated with other forms of coal development. Finally, these subalternatives may cause conflicts with other laws. For a particular coal deposit one portion may be amenable to being economically mined both underground mining methods and the other portion by surface mining methods; the application of MER would require the mine plan to show the recovery of both of these economically viable reserves. Over the course of a long-term coal management program, some of these joint mining tracts may present situations where neither type of mining is desirable. This could arise from a variety of situations including failure to obtain surface owner consent, land suitability determinations, hydrologic concerns, and other problems. If no discretion were available to exclude undesirable seams, mining of the entire property might not take place. Although it could be argued that new legislation is needed, the Department believes that MER does not apply to coal which cannot be lawfully mined and, in addition, that the Department retains the authority to do separate seam leasing, i.e., issue a lease which would grant the right to mine only specified coal seams. This latter authority, implicit in section 714 of the Surface Mining Control and Reclamation Act, has been used in several short-term leasing situations since Congress passed the Federal Coal Leasing Amendments Act.

5.4.8 Unsuitability Criteria

Until very recently, the Department issued coal leases for lands without specified standards for excluding lands from leasing. Local BLM managers had little incentive to seek out the best coal lands or even to avoid the worst lands, and the tendency was to lease lands without careful prelease consideration of environmental impacts. New laws affecting coal development including those which prohibit or greatly limit coal leasing or development on Federal lands.

The Department is now required to take steps to ensure that unsuitable lands are not mined. Section 523 of the Surface Mining Control and Reclamation Act, 30 U.S.C 1273, requires the Secretary to establish a Federal lands program to govern surface and underground coal mining operations on Federal lands; As part of that program, the local office of the land management agency will conduct a Federal lands review to determine if certain classes of Federal lands should be designated unsuitable for all or certain types of coal mining operations and to establish a process by which the public may petition to have Federal lands designated unsuitable for all or certain types of coal mining operations.

In November 1977, a task force composed of representatives from seven agencies and offices in the Department of the Interior (the Bureau of Land Management, the U.S. Geological Survey, the Office of Surface Mining, the Fish and Wildlife Service, the Bureau of Indian Affairs, Office of Economic Analysis, Office of the Assistant Secretary - Land and Water Resources) and the Forest Service from the Department of Agriculture began to formulate draft criteria to designate lands unsuitable for coal mining. In late May and early June of 1978, teams drawn from the task force field tested the draft criteria in four areas in the West. The task force's final report of the field tests was filed on September 11, 1978.

The criteria drafted by the task force incorporated the requirements of many laws affecting

The term unsuitability mining has statutory significance only with respect to standards arising under section 522 of the Surface Mining Control and Reclamation Act (SMCRA). The legal basis for the unsuitability criteria which will be described below is not uniform. Three different classes of sources of authority are involved, and each authority has different implications:

(a) Section 522(a) of SMCRA. This section establishes:

(1)

Mandatory designation of lands as unsuitable for surface mining if reclamation is not technologically and economically feasible.

(2) *Discretionary designation of lands as unsuitable for surface mining if operations will:*

- be incompatible with land-use plans;
- cause significant damage to important historic, cultural, scientific, and esthetic values and natural systems in fragile or historic lands;
- cause a substantial loss or reduction of long-range productivity of water supply or food or fiber products in renewable resource lands, including aquifers and aquifer recharge areas; or

- substantially endanger life and property on natural hazard lands, including areas subject to frequent flooding and areas of unstable geology.

(3) Both the discretionary and mandatory designations authorized by section 522(a) *do not apply to:*

- lands on which surface mining was being conducted on August 3, 1977;
- lands for substantial legal and financial commitments made prior to January 4, 1977.

(b) Section 522(e) of SMCRA. This section establishes:

(1) *Prohibitions against surface coal mining:*

- in units in various named Federal land systems such as the National Park System;
- where it will adversely affect any publicly-owned park or places in the National Register of Historic Sites;
- within 100 feet of the right-of-way line of a public road; and
- within 300 feet of an occupied dwelling or public building, school, church, community, or institutional building, public park, or within 100 feet of a cemetery.

Some of these prohibitions have opportunities for exceptions not relevant here.

(2) The prohibitions *do not apply to:*

- (a) operations that existed on August 3, 1977; or
- (b) "valid existing rights".
- Other statutory authority. Statutes other than SMCRA (including the Endangered Species Act, the Federal Land Policy and Management Act, the Wilderness Act, the Bald Eagle Protection Act) also require or authorize certain resource protection. Their application through the unsuitability criteria is discretionary on the part of the Secretary. Each statute must be examined to determine how it applies to existing leases.

Although the federal lands program (including the federal lands review) is exempt from the requirements of the National Environmental Policy Act (NEPA) for preparation of an environmental impact statement, 30 U.S.C. § 1292(d), the Department has decided to include in this statement an analysis of the environmental impacts of the unsuitability criteria as now proposed by the Department to give the public and the Department a better opportunity to evaluate these criteria before they are finally adopted. Final unsuitability criteria will not be adopted until after the final statement is filed with the Environmental Protection Agency.

Field tests of the proposed unsuitability criteria were held in late May and early June 1978 in four western coal areas to determine what impact on areas with potential for coal leasing would result from application of the unsuitability criteria. The criteria tested in June 1978 are, in some instances more stringent than the criteria selected for the preferred program (see Table 3-1). The following section describes the four test areas and the specific criteria utilized in the evaluation of areas unsuitable for coal mining.

The four units involved were the Wattis Planning Unit in Utah, the Decker-Birney Planning Unit in Montana, and the Campbell and Converse Planning Units both in Wyoming. The Wattis planning unit covers about 439 thousand acres and lies on the eastern flank on the Wahsatch Plateau in Carbon and Emery counties, Utah. Approximately 250 thousand acres

of coal lands were examined in the field test. The Campbell and Converse Planning Units are in northeastern Wyoming, encompassing about 2.3 million act acres in Campbell County and 1.4 million acres in that part of Converse County north of the North Platte River. The effects of the unsuitability criteria were examined on about 500 thousand acres of coal lands, estimated to contain 67 billion tons of Federal coal resources. The Decker-Birney Planning Unit lies in Rosebud and Big Horn Counties in southeastern Montana, just north of the Wyoming border. The area covers about 900 thousand acres of which slightly more than 250 thousand acres of coal lands were examined in field testing of the criteria. The Federal coal lands in the area examined are estimated to contain about 13 billion tons of Federal coal resources.

The Decker-Birney and Campbell-Converse Planning Units lie in the Powder River Region. The Wattis area is in the Uinta-Southwestern Utah Region.

The various criteria and, in some instances, alternative criteria which were the subject of the field tests are set forth in Table 5-72. This Table is also found in the September 11, 1978, final report of the Task Force.

Table 5-73 indicates the percentage of Federal coal (by tonnage) affected by application of the draft criteria to the field test areas. Based on overlay mapping of the areas affected by the several criteria, their cumulative application in the Decker-Birney Planning Unit excluded about 4.1 billion tons of coal or about one-third of the Federal coal resource. In the Campbell-Converse Planning Unit, slightly less than half of the Federal coal resource (32 billion tons) was pre-empted by application of the criteria. In both areas the single criterion which excluded the most coal was criterion 15, fish and wildlife habitat of high state interest.

Insufficient data limited the testing of four criteria (state unsuitable lands, state-listed endangered species, national resource waters, and migratory bird habitat) in both the Wyoming and Montana test areas. Additionally, data were lacking for alluvial valley floors in the Decker-Birney test area and for eagle nest sites and eagle concentration areas in the Campbell-Converse test area. If data were available for these criteria, additional Federal coal lands would likely be excluded from further consideration for coal leasing in both areas.

The field test of the criteria in the Utah area showed little affect on Federal coal availability because the vast majority of the coal in the area is accessible only by underground methods and the criteria are principally oriented to the exclusion of surface mineable coal.

These field tests examined the draft criteria in Table 5-72. After studying these results, the Under Secretary selected 24 more tightly drawn criteria for the preferred program: these are included in the example regulations. These criteria are presently being used on an interim basis in BLM ongoing land-use planning.

5.4.9 Role of Industry Nominations

Until the early to middle 1960's, the Department did not coordinate the issuance of coal leases on public lands with any sort of a planning system. Starting in the 1960's, the Bureau of Land Management began to bring its lands under the control of plans that identified land-use capabilities and demands. In

1976, Congress expressly required that land-use planning be done for all BLM-managed lands. Under the Federal Coal Leasing Amendments Act of 1976, planning is specifically required for coal and the Department may not issue a lease unless the mining is compatible with a plan (or the equivalent of a plan for certain lands where the Federal Government has only minor interests).

One key question has been to decide the proper role for industry nominations in a land-use planning oriented leasing system. This involves considerations of how nominations affect the amount and location of coal to be offered for lease.

Three major sub-alternatives exist. First, the planning system would evaluate the coal resource and any environmental impacts after individual firms expressed their need for new coal leases. These expressions could either be by application or nomination. The land-use planners would examine these expressions in light of the plan and would decide whether mining would be "compatible" with other uses. Lands not identified by industry would not be considered for leasing. This alternative could be used both as part of systems where industry also controls the overall leasing rate and those where it does not. The EMARS II program followed this pattern and both the rate and location of leases was dependent on industry nominations. The second sub-alternative is to have a formal industry role after the government has identified through land use planning what areas are unsuitable for mining and what areas are acceptable for further considerations for leasing. This is the sub-alternative used in the preferred program coupled with a policy of government control of the overall leasing rate. The third sub-alternative is to have no formal industry role until the time a lease sale is held. Under this approach government planners would have the responsibility to determine both rates and location of leasing.

The only practical experience with these subalternatives is that gained under the EMARS II program.

Under EMARS II, industry nominated land it wanted the Department to offer for leasing. Persons opposed to leasing nominated where leasing should not to take place. Nominators were requested to rank their tracts in order of preference. Nominated lands were to be reviewed for environmental considerations and lands without significant problems would normally be offered for leasing, and leased if the high bid equaled or exceeded fair market value. "Highly ranked" tracts (those nominated by more than one company or tracts highly ranked by a company) were to be offered first. Diligent development and advance royalty provisions were intended to limit speculative holdings of leases.

As part of EMARS II, the Department issued a formal request for nominations on June 1, 1976. The nominations process was boycotted by a large number of western environmental groups. The results of those who did nominate can be summarized as follows:

Nominations in favor of leasing were received from approximately 300 sources, including coal companies, and from private citizens, many of whom own land over Federal coal deposits.

These nominators identified about 1,000 separate areas covering more than 3 million acres they would like to see offered in the event of a Federal coal lease sale. Some 75 nominations of 200 tracts covering more than 3 million acres

TABLE 5-72

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED INFORMATION PROCESS
<u>CRITERION 1-LEASING EXCLUSIONS</u>			
(1) All Federal lands included in or candidates for inclusion in the following land systems or categories are not available for coal leasing: National System of Trails, National Wilderness Preservation System, Wild and Scenic Rivers System, National Recreation Areas, Custer National Forest (exclude surface mining only) and Federal lands in incorporated cities, towns, and villages.	A lease may be issued for underground coal mining within the Custer National Forest with the consent of the Department of Agriculture.	1. SMCRA, Sec. 522(e) P.L. 95-87 2. Section 16 of P.L. 94-377	Maps of existing Federal lands within the various land systems. Maps of potential additions to these systems from appropriate agencies. BLM Laster Title Plats.
<u>CRITERION 2-RIGHTS-OF-WAY AND EASEMENTS</u>			
(2) Federal lands that are within rights-of-way or easements for residential, commercial, industrial, public purposes and agricultural crop production shall be excluded from coal leasing. Whenever possible, Federal leases should exclude areas identified in section 522(e) of SMCRA (lands within 100' outside of ROW of public highway or within 100' of cemetery, and within 300' of occupied building, school, church, community or institutional building or public park or within 300' of an occupied dwelling unless waived by the owner thereof.)	A lease may include such areas if: (a) it is determined that coal development (e.g. underground mining) will not interfere with the purpose of the right-of-way or easement, or (b) the ROW or easement was granted for mining purposes, or (c) the ROW or easement was issued for a purpose for which it is not being used, or (d) where the parties involved agree to leasing or (e) if it is impractical to exclude such areas due to location of coal and method of mining and such areas can be protected through use of appropriate stipulations.	1. Departmental Policy 2. Section 522(e) of P.L. 95-87 SMCRA	This determination would be made on a case-by-case basis using available plat data, country road maps, etc.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 3-ROADLESS AREAS - ALTERNATIVE 1</u>			
(3)(a) Federal lands designated as roadless or under review as candidate roadless areas are unsuitable for surface mining and shall be excluded from coal leasing until the Congress determines which portions of the roadless lands will be included within the Wilderness System.	No exceptions except valid existing rights will be honored. Where valid coal PRLAs are within roadless or wilderness study areas, no leases will be granted until wilderness review is completed. For valid PRLAs option of exchange should be considered.	1. P.L. 88-577 (1964 Wilderness Act) 6USC 1133 2. FLPMA, 43USC 1702 and 1782 3. Forest Service Rare II in Nov. 19, 1977 F.R.	Maps showing roadless, wilderness study and wilderness areas from BLM, FWS, NPS, and Park Service.
<u>CRITERION 3 - ALTERNATIVE 2</u>			
(3)(b) BLM administered lands designated as roadless and under review for wilderness values will be excluded from coal leasing until such time as the wilderness study areas have been identified. At that time lands within the roadless areas but outside the wilderness study areas may be considered for coal leasing. The areas remaining within the wilderness study areas will be excluded from competitive coal leasing until the Congress determines which portions of such lands will be included within the Wilderness System. At that time lands outside of the designated wilderness areas may be considered for leasing on a case-by-case basis with a suitable buffer zone around the designated wilderness areas. Forest Service administered lands designated as roadless and under review for wilderness values will be excluded from coal leasing until such time as the Congress determines which portions of such lands will be included within the Wilderness System.			

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 3 - ALTERNATIVE 3</u>			
(3)(c) BLM administered lands designated as roadless are unsuitable for mining and shall be excluded from coal leasing.			
<u>CRITERION 4-SCENIC AREAS - ALTERNATIVE 1</u>			
(4)(a) Scenic Federal lands designated by visual resource management analysis as Class I or II (areas of outstanding scenic quality and/or high visual sensitivity) but not currently on the National Register of Natural Landmarks, shall be excluded from coal leasing.	An exception may be granted if it can be determined that coal mining will not diminish or adversely affect the scenic quality of the designated area.	P.L. 94-579, sections 201 and 202. Departmental Policy	Class I or II according to BLM classification system. The criterion should also apply to comparable rankings of scenic values by other land managing agencies: e.g., FS.
<u>CRITERION 4 - ALTERNATIVE 2</u>			
(4)(b) Scenic Federal lands designated by visual resource management analysis as Class I (areas of outstanding scenic quality) but not currently on the National Register of Natural Landmarks, shall be excluded from coal leasing.	Same as 4a.	Same as 4a.	
<u>CRITERION 5-LANDS USED FOR SCIENTIFIC STUDIES</u>			
(5) Federal lands being used for scientific studies involving food and fiber production, natural resources, or technology demonstrations and experiments are unsuitable for mining and shall be excluded from coal leasing.	A coal lease may be issued: (1) with the concurrence of the principal scientific user or agency, or (2) where the mining could be done in such a way as to not jeopardize the purpose of the study.	1. Departmental Policy 2. SMCRA 3. FLPMA	Information on such agreements and the location of such sites are maintained by the surface managing agencies.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 6-STATE UNSUITABLE LANDS - ALTERNATIVE 1</u>			
(6)(a) Under the provisions of section 522 of the SMCRA where States have designated non-Federal lands to be unsuitable for surface mining and such non-Federal lands are contiguous to or cornering on Federal lands, a buffer zone of Federal lands of (1) mile from the boundary of the designated non-Federal lands shall be unsuitable for surface coal mining and unavailable for Federal leasing. In no case should the area of the buffer zone exceed the area of the State lands designated as unsuitable.	<ol style="list-style-type: none"> Any exceptions applicable to the State lands should also be applied to this Federal buffer zone. Federal land management agencies may modify or eliminate buffer zones as necessary to maintain consistency with the purpose of the State designation or States may petition for changes in buffer zones. States must concur with changes in Federal buffer zone. Leasing may be allowed within the buffer zones if the coal would be mined by underground mining methods and would not affect the State designated lands. 	<ol style="list-style-type: none"> P.L. 95-87, Sec. 522 SMCRA Departmental Policy 	Assume existing State recreation and preservation areas will be designated unsuitable by States. Also municipal water supply sources and habitat identified by the State as critical to State designated species.
<u>CRITERION 6 - ALTERNATIVE 2</u>			
(6)(b) Eliminate this criteria and direct Departmental land managing agencies to determine buffer zones around State designated unsuitable lands on a case-by-case basis.			
<u>CRITERION 7-HISTORIC LANDS AND SITES - ALTERNATIVE 1</u>			
(7)(a) Sites on Federal lands which are on or eligible for the <u>National Registry of Historic Places</u> (historic, archeological, architectural, and cultural) and an appropriate buffer zone around the outside boundary of the property are unsuitable for coal mining and shall be excluded from leasing when such areas or places are of national significance.	<p>Leasing may be allowed where:</p> <ol style="list-style-type: none"> Areas or sites are of regional or local significance and with the concurrence of the State government. 	<ol style="list-style-type: none"> National Historic Preservation Act of 1966, (16 U.S.C. 470 et. seq.) 	Listing of the <u>National Registry of Historic Places</u> from the Heritage Conservation and Recreation Service and listing of properties eligible for the Registry from appropriate State, local, and Federal agencies.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 7 - ALTERNATIVE 2</u>			
(7)(b) Same as above except eliminate condition of "national significance" in order to be excluded from consideration for Federal coal leasing	<p>2. The effects of coal mining can be satisfactorily mitigated through use of mining technology and the Advisory Council and State Historic Preservation Officer have consented to mining, if the site or property is on the <u>National Registry</u>.</p> <p>3. The cultural resource areas can be studied and recovered or they contain items that can be moved or restored without any loss of significance.</p>	<p>2. Archaeological and Historic Preservation Act Amendments of 1976 (16 U.S.C. 470(b) et. seq.)</p> <p>3. Historic Sites, Buildings and Antiquities Act of 1935 (16 U.S.C. 461-467)</p> <p>4. Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469)</p>	
<u>CRITERION 8-NATURAL AREAS</u>			
(8) Federal lands designated as natural areas or as National natural landmarks, and Federal lands which will be on or eligible for the <u>National Registry of Natural Areas</u> (ecologic, geologic, scenic, and lands with wild or scenic significance) are unsuitable for surface coal mining and shall be excluded from coal leasing when such areas are of national significance.	<p>Leasing may be allowed in these areas if:</p> <p>1. Such areas or sites are of regional or local significance and with the concurrence of the State government and, where appropriate, the Heritage Conservation and Recreation Service.</p> <p>2. It can be determined that the effects of mining will be mitigated through the use of appropriate mining technology and with the concurrence of HCRS.</p>	<p>1. Departmental Policy</p> <p>2. Legislation dealing with the establishment of a National Heritage Program has been proposed which will establish a <u>National Register of Natural Areas</u>.</p>	Listing of any natural areas designated by Federal agencies. Park Service and HCRS may also have identified some natural areas.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
	3. The mining of the coal resource will enhance information recovery (e.g., paleontological sites).	3. S.O. 3017 which establishes the Heritage Conservation and Recreation Service (HCRS).	
<u>CRITERION 9-ENDANGERED SPECIES</u>			
(9)(a) Legally designated critical habitat for Federal threatened/endangered (T/E) plant and animal species are unsuitable for coal mining and shall be excluded from coal leasing.	Leasing may be allowed if after consultation with FWS it can be determined that the species habitat will not be adversely affected by coal development or that complete mitigation is possible.	1. Endangered Species Act of 1975, (30 U.S.C. 181, et. seq.)	Maps of critical habitat for endangered and threatened species from land management agencies and FWS.
(9)(b) Crucial value habitat for Federal T/E species as determined by the FWS and the land management agency where the presence of T/E species has been scientifically documented are areas of critical environmental concern and are excluded from coal leasing.		2. Departmental Policy	Maps showing suspected (documented) T/E species presence. Information on high value habitat from wildlife inventories and land management planning documents.
(9)(c) High value habitats for Federal T/E species, as determined by FWS and the land management agency, shall be considered for leasing only after it is scientifically determined that the area is not a critical or crucial habitat.		3. Authority for ACEC in FLPMA, (43 U.S.C. 1702)	For brief definitions of critical, crucial, and high value habitats see page 37 of March 1, 1978 draft criteria of Coal Task Force 2.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 10-STATE LISTED ENDANGERED SPECIES</u>			
(10) Habitats deemed critical or crucial for State listed endangered or threatened plant and animal species as determined by the land management agency in coordination with the States and the FWS are unsuitable for mining and shall be excluded from coal leasing.	1. Leasing may be allowed if after consultation with the State, it can be determined that species habitat will not be adversely affected by the coal development or that complete mitigation is possible.	1. FLPMA (94-579) 2. Sikes Act Sec. 204	Information on State species from appropriate State agency and the FWS.
<u>CRITERION 11-BALD AND GOLDEN EAGLE NESTS</u>			
(11) Bald and Golden Eagle nests that are determined to be active and a buffer zone of land included in a $\frac{1}{4}$ mile radius from the nest are areas which shall be excluded from coal leasing.	A lease may be issued if: 1. Mining can be conducted in such a way and during periods of time that eagles will not be disturbed during breeding season. 2. A permit or special approval is granted by the FWS to allow the eagle nest to be moved. (Permit regulations are currently undergoing review by FWS.)	1. Bald Eagle Protection Act (16 U.S.C. 668), includes all eagles. 2. Endangered Species Act of 1973 (16 U.S.C. 1531). (Bald eagles are listed as endangered species in all States except 3 where they are listed as threatened.)	Location of active eagle nests. Use definition of active provided on page 39 of March 1 draft criteria. Additional information on inventoried active eagle nests available from the FWS and land management agencies.
<u>CRITERION 12-EAGLE ROOST AND CONCENTRATION AREAS</u>			
(12) Bald and Golden Eagle roost and concentration areas used during migration and wintering are areas of critical environmental concern and shall be excluded from coal leasing. Where such areas have been designated as critical or crucial habitat for Bald Eagles, coal leasing shall be excluded.	A lease may be issued: 1. If mining can be conducted in such a way and during periods of time that eagles will not be adversely disturbed or	1. Bald Eagle Protection Act (16 U.S.C. 668).	Use existing inventory data of roost and concentration areas from BLM FWS, and FS.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
	2. For Bald Eagles where such areas are designated as critical or crucial habitat if the exception under endangered species criteria are met.	2. Endangered Species Act of 1973 (16 U.S.C. 1531). 3. Authority for ACEC in FLPMA (43 U.S.C. 1702).	Definitions of "roosting and concentration" areas from page 40 of March 1 draft criteria.
<u>CRITERION 13-RAPTOR CLIFF NESTING SITES</u>			
(13) Federal lands containing raptor cliff nesting sites with active nests and a buffer zone of Federal lands $\frac{1}{4}$ mile radius from the next site are areas which shall be excluded from competitive leasing.	A lease may be issued: 1. Where it can be determined that coal mining will not adversely impact the nesting sites during the breeding season. 2. Where nest sites may be moved with concurrence of the FWS.	1. Migratory Bird Treaty Act. 2. Departmental Policy.	Use existing inventory data and any additional inventory data from the FWS. Definitions of active nests from page of March 1 draft criteria.
<u>CRITERION 14-MIGRATORY BIRDS</u>			
(14) Federal lands which are habitat for migratory bird species of high Federal interest (as determined by the FWS) that are determined to be critical or high priority habitat by the land management agency in consultation with FWS are areas of critical environmental concern and shall be excluded from coal leasing.	A lease may be issued: 1. Where it is determined by the land management agency in consultation with FWS that coal mining will not adversely impact the migratory bird habitat during periods when such habitat is used by the species. 2. Where the land management agency in consultation with the FWS determines that the impact on the habitat can be mitigated through use of appropriate mining and reclamation technology and lease stipulations.	1. Migratory Bird Treaty Act. 2. Fish and Wildlife Act. 3. Departmental Policy.	For definition of criteria and high priority habitat values see page 44 of March 1 Task Force draft.

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<p><u>CRITERION 15--CRUCIAL HABITAT FOR HIGH INTEREST FISH AND WILDLIFE SPECIES - ALTERNATIVE 1</u></p> <p>(15)(a) Federal lands that have critical or high priority fish and wildlife values for species of high State or Federal interest are areas of critical environmental concern and shall be excluded from leasing.</p> <p><u>CRITERION 15 - ALTERNATIVE 2</u></p> <p>(15)(b) No specific <u>a priori</u> criteria for this topic; areas containing high fish and wildlife values protected on a case-by-case basis based on resource values and mitigation potential.</p>	<p>A lease may be leased where:</p> <ol style="list-style-type: none"> 1. It can be determined that the coal mining impacts on the habitat will not adversely affect the species during critical periods for breeding, migrating, feeding, or wintering. 2. It can be determined that the impacts of coal mining can be mitigated through use of appropriate mining and reclamation technology. 	<ol style="list-style-type: none"> 1. Fish and Wildlife Coordination Act (16 U.S.C. 661-667(e)), (particularly where leasing could result in diversion or modification of streams or other bodies of water). 2. Wild Freeroaming Horses and Burros Act (16 U.S.C. 1331-1340) (where leasing would impact such habitat.) 3. Anadromous Fish Conservation Act (16 U.S.C. 757(a)-757(b)). 4. Departmental Policy. 	<p>Various inventories of fish and wildlife habitats from BLM, States, FWS, etc.</p> <p>For definitions of "critical and high priority" fish and wildlife values see page 44 of March 1 draft task force criteria.</p>

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 16-WETLANDS</u>	<p>A lease may be issued where:</p> <ol style="list-style-type: none"> 1. The use of appropriate mining or reclamation technology will not significantly affect the wetlands or will provide for complete restoration and mitigation. 2. Where the wetlands contain no significant values for ground-water recharge, fish and wildlife habitat, recreation or scientific study. 	<ol style="list-style-type: none"> 1. E.O. 11990, May 1977 (Wetlands Executive Order.) 2. Fish and Wildlife Coordination Act (16 U.S.C.A. 661). 3. Departmental Policy. 	<p>Use wetland inventory data from land management agencies, FWS and SCS.</p>
<u>CRITERION 17-RARE VEGETATIVE SPECIES AND COMMUNITIES</u>	<p>Leasing may occur where:</p> <ol style="list-style-type: none"> 1. Mining can be conducted in such a way as to not impact the plant species. 2. Coal development will improve the habitat for the plant species. 3. It is <u>demonstrated</u> that complete mitigation is possible by use of reclamation technology. 	<ol style="list-style-type: none"> 1. Departmental Policy on natural diversity. 	<p>List of rare species by ecoregions-identification of habitat types.</p>
<u>CRITERION 18-ALLUVIAL VALLEY FLOORS</u>			
(18) To be provided by OSM Task Force.			

TABLE 5-72 (Continued)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 19-FLOODPLAINS - ALTERNATIVE 1</u>			
(19)(a) Riverine, coastal, and special floodplains (100-year recurrence interval) are natural hazard lands and shall be excluded from coal leasing.	Leasing may be allowed where (1) leasing a particular tract is the only practical alternative and (2) potential for harm to people or property and natural and beneficial values of floodplains can be minimized through use of demonstrated and available mining and mitigation measures.	1. Executive Order 11988, May 24, 1977, Floodplain Management.	For description of E.O. and guidelines see paper entitled "Floodplains" attached to March 1 Task Force draft. HUD/Corps of Engineers floodplain maps. Historical records, USGS modeling.
<u>CRITERION 19-FLOODPLAINS - ALTERNATIVE 2</u>		2. Guidelines for Implementing Executive Order 11988-Water Resources Council, Feb. 10, 1978.	
(19)(b) Same as above except 100-year recurrence interval is replaced by a 500-year interval.			
<u>CRITERION 20-MUNICIPAL WATERSHEDS</u>			
(20) Federal lands which have been committed to use as municipal watersheds are unsuitable for mining and should be excluded from coal leasing.	Leasing may be allowed: 1. Where it can be determined that mining will not adversely affect the watershed to any significant degree, or 2. Where the municipality or water users concur in the issuance of the lease.	1. Policy from Safe Drinking Water Act. 2. Departmental Policy.	

TABLE 5-72 (Concluded)

SUITABILITY CRITERIA

CRITERIA AND ALTERNATIVES	EXCEPTIONS	AUTHORITY	DATA NEEDED OR INFORMATION PROCESS
<u>CRITERION 21-NATIONAL RESOURCE WATERS</u>	1. The buffer zone may be eliminated or reduced in size where it can be determined that it is not necessary to protect the National Waters.	1. Water Pollution Control Act. 2. Departmental Policy.	
<u>CRITERION 22-PRIVATE SURFACE-FEDERAL COAL</u>	A lease may be issued in such areas where: 1. The surface was owned in fee by a coal company on August 3, 1977 (date of SMCRA). A company which has a lease for the surface or some other arrangement other than fee ownership does not qualify as a surface owner. Coal Company is defined as any corporation, partnership, association, or company which has mined or is mining coal resources.	1. Departmental Policy.	

TABLE 5-73

Lands Unsuitable Field Test Summary

Criteria	Percentage (Tonnage) of Federal Coal Affected		
	Wyoming	Montana	Utah
1. Leasing Exclusions	<.1%	10.3%	.4%
2. Rights-of-Way	.7%	8.5%	5.4%
3a. Roadless area with designation by Congress	-	1.6%	-
3b. Roadless area until wilderness study	.2%	-	-
3c. All roadless areas	-	-	-
4a. Scenic Areas (Class I and II)	No impact	5.4%	6.1%
4b. Scenic Areas (Class I only)	None In	Any Coal	Areas
5. Scientific Study Lands	.2%	0%	1.2%
6a. Buffering State Unsuitable (fix)	No States Have Yet Identified Areas		
6b. Buffering State Unsuitable (vary)	" " " " " "		
7a. Historic Lands of Nat'l. Sig.	< .1%	2.4%	.62%
7b. Historic Lands	None	100%	-
8. Endangered Species	None	.8%	.75%
9. Endangered Species	1.0% ^(b)	.2%	29.7% ^(b)
10. State Endangered Species	N.R.	N.R.	N.R.
11. Eagle Nest Sites + ¼ mile	N.R.	.5%	N.R. ^(d)
12. Eagle Concentration Area	N.R.	0%	2.1%
13. Raptor Cliff Nesting	.4%	1.6%	-
14. Significant Migratory Bird State	-	< 1%	-
15. High-Interest Habitat	34.9%	98.2%	64.8%
16. Wetlands	N.R.	.07%	-
17. Rare Vegetative Communities	N.R.	0%	.8%
18. Alluvial Valley Floors	4.6%	N.R.	N.R.
19. 100-year Flood plain	3.8%	3.7%	.9%
20. Municipal Watershed	N.R.	0%	-
21. National Resource Waters	-	0%	-
22. Private Surface - Federal Coal	82% ^(c)	89.9%	81%

NOTES

- (a) Almost all of Utah land would fallout under exceptions for underground mining technology.
- (b) Largely based on data for black footed ferrett that is suspect.
- (c) If coal company ownership is excluded in Wyoming this figure drops to 51.6%.
- (d) State participants feel amount of coal affected could prove substantial largely because of buffer zone.

REGIONAL IMPACTS

were registered against leasing. By state, the results of the nominations were:

- WYOMING - 86 nominators favored coal leasing on 300 tracts totaling 578,000 acres, with 4 nominations registered against leasing on 44 tracts involving several million acres.
- UTAH - 37 nominators favored leasing on 110 tracts comprising 292,000 acres; there were no nominations against leasing.
- COLORADO - 68 nominators identified 190 tracts totaling 483,000 acres; there were no nominations against leasing.
- NEW MEXICO - 19 nominators favored leasing on 66 tracts totaling 298,000 acres; one nominator listed one tract comprising 3,300 acres on which leasing should not be considered.
- OKLAHOMA - 15 nominators identified 20 tracts, totaling 44,000 acres; there were no nominations against leasing.
- MONTANA - 48 nominators favored leasing 187 tracts totaling 989,000 acres; 27 nominators identified 28 tracts comprising 80,000 acres as unsuitable for leasing.
- NORTH DAKOTA - 9 nominators favored leasing on 39 tracts totaling 428,000 acres; 39 nominators identified 39 tracts covering 16,000 acres as unsuitable for leasing.
- ALABAMA - 11 nominators favored leasing on 24 tracts covering 37,000 acres; one nomination, signed by 150 individuals who opposed coal leasing in the Bankhead National Forest in Northern Alabama, listed 81 tracts comprising 146,000 acres considered unsuitable for leasing.

The Department's analysis of these nominations suggests that the nominations process was less useful than might have been desired. First, significant numbers of people (both industry and other groups) did not participate because lack of sufficient time. Second, many nominations were unsupported by data or other evidence to show why the tract should be leased. Third, some companies nominated significantly more coal than they (or perhaps the whole coal industry) could reasonably be expected to produce. For example, in at least thirteen instances a company nominated more lands than it would be allowed to hold under the acreage limitations in the Mineral Leasing Act of 1920. Others nominated lands which clearly do not contain any coal. The following limited conclusions can be drawn from the nominations:

1. Competitive interest was highest in Southern Campbell County, Wyoming, where at least 10 companies nominated overlapping tracts.
2. Greatest overall interest for coal was shown in Montana (where virtually all known coal areas were nominated) and in Wyoming (where nearly 600,000 acres were nominated).
3. In Colorado, New Mexico and Oklahoma, utility companies rather than coal companies, showed the highest interest.

Criticisms of EMARS II focus on two areas: (1) land-use planning followed industry nominations; and (2) the system minimized the opportunity for control over development-related social and economic problems, since the location and

rate of leasing were controlled by industry. With respect to nominations against leasing, many people objected that it was unduly burdensome to force them to express their views for the entire nation and to do so prior to seeing what lands industry was interested in developing.

The previous sections of this chapter analyze the differences in the amount of lands to be leased that might occur under a lease to meet industry indications of need alternative and other alternatives calling for greater degrees of government planning of when and where leasing will occur. Since the BLM has not completed revising existing land use plans to conform to new statutory requirements such as unsuitability criteria, it is not possible to directly compare the locational effects of these three subalternatives. The discussion which follows analyzes potential differences on a general level.

In comparison to the situation which existed in, for example, 1970, Congress has now passed extensive laws governing coal mining and development. All coal development must comply with these laws. The requirements of these laws include:

- emissions standards for coal burning
- water quality standards
- revegetation and reclamation standards
- rents and royalties for federal coal
- mine health and safety
- transportation costs
- land-use planning.

Since many major elements of the coal production cycle are regulated and will be constant under any federal coal management system the analysis of the relative impacts of these subalternatives must focus on the unregulated aspects of coal development that they might effect. With respect to location of leases, the primary elements are social and economic impacts. Current laws do not impose any obligations on a company to avoid triggering growth in an area in excess of the rate that can be absorbed by the affected communities. There is no obligation to build schools, roads, sewage facilities or homes. A great many companies have assumed the burden of assisting communities in preparing for the new development, but it is well documented that coal development has created boom-town conditions in many towns in the West. The current pattern of leased tracts developed from a regulatory framework where industry had a free hand. Continued industry control over tract selection is likely to result in similar future effects.

The one important environmental impact of giving greater control over location of future federal coal leases to industry is a loss of the opportunity to control social and economic costs associated with rapid growth in rural areas. The converse of this is that the impact of more government control may be to increase coal costs if it discourages development in least costly coal areas to avoid adverse social impacts. It is not certain that greater government control in tract selection will necessarily lead to higher costs. Coal companies which have tried to anticipate coal development have sought to gain competitive advantage by purchasing surface estates over federal coal or by buying private coal adjacent to federal coal. Their choices of properties could be based as much on a reliable supply of coal as obtaining the least cost coal. They may have also focused on areas that were

easy to explore. The government may be able to find equally low-cost coal in areas which offer less opportunity for control by a single company. The degree to which this trade-off is made is impossible to quantify. It does seem very likely, on the other hand, that greater government control will reduce social impacts. The preferred program will assist in:

1. Predicting future development so that planning and capital construction can precede coal development.

2. Consulting with State and local officials to determine where in the State coal development can be accommodated with least social impacts.

3. Using regional tract ranking to ensure that tracts offered for lease offer the combination of least social cost and highest economic efficiency. Greater government control over the location of coal lease tracts should lessen the environmental effects of coal development by reducing development in areas which are unable to absorb additional impacts and by encouraging properly-paced development in other areas. Table 5-74 summarizes the effects of the three subalternatives.

5.5 REFERENCES

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COMPARISON OF SUBALTERNATIVES

	<u>Option 1</u>	<u>Option 2</u>	<u>Option 3</u>
1. Determination of Production goals	Industry	Government	Government
2. Identifies areas for leasing	Industry	Government	Government
3. Identifies tracts for leasing	Industry	Industry	Government
4. Defines areas for Environmental Planning	Industry	Government	Government
5. Cost of Planning and Administration	-----INCREASING-----▶		
6. Chances for Environmental Mistakes	-----DECREASING-----▶		
7. Chances for Production Shortages	-----INCREASING-----▶		
8. Consideration of socio-economic concerns	-----INCREASING-----▶		

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CHAPTER 6

MITIGATION OF MAJOR ADVERSE IMPACTS OF A FEDERAL COAL MANAGEMENT PROGRAM

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CHAPTER 6

MITIGATION OF MAJOR ADVERSE IMPACTS OF A FEDERAL COAL MANAGEMENT PROGRAM

6.1 INTRODUCTION

In this environmental impact statement, mitigation means a policy, procedure, or action intended to avoid, minimize, or help compensate for damage that could be caused by decisions made by the Department of the Interior about the management of Federal coal. Mitigation is intended to help protect individuals and communities from adverse social and economic impacts, as well as to protect the physical environment. This chapter recapitulates those aspects of any of the alternatives for a Federal coal management program and discusses other discretionary measures which would tend to lessen adverse environmental impacts. The impact analysis in the previous chapter (Chapter 5) does not include those mitigating measures required by law or regulation.

The preferred alternative Federal coal management program described in Chapter 3 of this statement requires that in deciding whether to lease or not to lease, and in deciding where, in what amounts, and under what circumstances leasing might take place, decisions about the management of Federal coal must assure that the environment be protected and that the interests of individuals and communities be considered. These mitigation measures are a direct consequence of decisions by the Secretary, instructions from the President, and requirements included in laws recently enacted by the Congress.

The President, by memorandum of May 24, 1977, instructed the Secretary to "manage the coal leasing program to assure that it can respond to reasonable production goals by leasing only those areas where mining is environmentally acceptable and compatible with other land uses." The President further directed that the Department "scrutinize existing Federal coal leases (and applications for preference right leases) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications."

In response to these directives, the Department has set as one of its primary goals the "use of land use planning and effective enforcement of environmental laws to assure that Federal coal is produced in an environmentally acceptable manner and in a way that is responsive to local communities and private land owners affected by Federal coal development." Of equal importance is the Department's emphasis on consultation and cooperation with state governments, because only through such a cooperative effort could the Department be assured of the effectiveness of mitigation measures designed to protect against adverse social and economic impacts of Federal coal management decisions.

In developing and analyzing the preferred program and alternatives described in this statement, the Department was able to act in response to definitions of environmental acceptability and social and economic responsibility which were not available when the enjoined EMARS II leasing program was developed (see section 1.2.4). During the development of the previous program, controversy about what constituted acceptable environmental and socioeconomic mitigation created an atmosphere of uncertainty, which prevented all parties interested in Federal coal management from making secure assumptions about the mitigation measures which might accompany Federal coal management decisions.

Enactment of the Federal Coal Leasing Amendments Act of 1976, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977 established, after several years of Congressional debate, specific goals and standards for mitigation, and specific procedures to assure that the goals are achieved and the standards are met. These laws ended the uncertainty about the legal and policy framework and provided rules for the management of Federally owned coal, the planning and management of the public lands and other Federally managed natural resources, and the regulation of the environmental effects of coal mining. As a result, the uncertainty about the environmental, social, and economic consequences of Federal coal management decisions have been minimized, and the effectiveness of mitigating measures are now more predictable.

In addition to the laws already referred to, many other laws provide standards and procedures requiring avoidance of, or recovery from, damage to the environment and disruption of local communities. Any Federal coal management program that might be adopted by the Secretary would recognize and include the responsibility for compliance with these laws. Statutory standards and procedures would be applied throughout the program, in the land use planning process, in the ranking, selection, and sale of specific tracts, and in stipulations attached to leases and mining plans.

The Department also recognizes its responsibility to use its discretion in the application of additional measures which would further minimize environmental and community disturbance. Certain of these discretionary measures, particularly the additional standards and procedures that will help give direction to the judgement exercised by the Department's resource managers in the field, are integrated into the preferred program and several of the alternatives. Any program implemented by the Secretary would require that

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other standards and procedures, if warranted, be identified and applied to supplement those described in this statement.

The discretionary measures for environmental impact mitigation are discussed in section 6.2. The site-specific nature of the data required to apply these mitigating measures and assess their effectiveness significantly diminishes the opportunity to fully address such measures in this broad-based statement. The social and economic impacts of coal development and their mitigation are addressed in section 6.3.

Throughout the discussion in the following sections, it is assumed that mitigation measures not only provide direct protection of people, communities, and resources, but also produce, as a secondary consequence, a reduction in conflict and an increase in acceptance of individual resource management decisions. Financial and administrative burdens for the government, prospective lessees, and all interests affected by leasing, will be reduced because the emphasis on early application of protective and mitigative measures will identify, resolve, or avoid conflicts. This, in turn, will provide assurance that the Federal coal development decisions which are made will be subject to less delay and uncertainty. A successful mitigation program, while aimed at minimizing environmental, social, and economic damage to individuals, communities, and natural resources, will also allow coal producers and users to make more timely and secure development plans. The producers' interest in the success of the mitigation efforts is evident and will serve to reinforce the effectiveness of mitigation elements of the Federal coal management program.

6.2 ENVIRONMENTAL MITIGATION STRUCTURE OF THE PREFERRED PROGRAM AND CERTAIN OF THE ALTERNATIVES

The preferred program and several other alternatives contain many structural environmental decision points. The key mitigation elements of the preferred program and the alternatives are described in Chapter 3, but are reviewed briefly in the following paragraphs from the viewpoint of opportunities they provide to protect environmental values.

The most important of the structural environmental features of the preferred program and several of the alternatives is the use of unsuitability criteria to identify and protect resources of major importance. The need to review Federal coal lands and make unsuitability determinations is set out in section 522 of the Surface Mining Control and Reclamation Act of 1977. The use of criteria to establish a standard list of resource values which must be considered by the land manager is based on the preference expressed by the Secretary. The Secretary recognized the need to ensure both uniformity and consistency in the manner in which the decisions on unsuitability for coal mining are made. The application procedure accompanying the criteria ensures that each potential resource conflict will receive careful, individual consideration before the land manager decides whether to exclude an area from all or certain types of coal mining, or whether to require mitigation measures that would allow mining. The application of these criteria, based on a comprehensive review and, where needed, on an inventory of an area's resources, would provide a threshold of protection of

those resources and interests which could be affected by Federal coal development.

By incorporating unsuitability criteria procedures in the land use planning process, the Department would not abandon its basic resource management system, which makes balanced judgments about resource use. Decisions which determine the best combination of uses for all the resources under the jurisdiction of the Federal resource manager would still be made after application of unsuitability criteria. Coal leasing could be prohibited, or allowed to proceed under special conditions, on lands where the land manager determines that coal mining would seriously conflict with important local resources. The key decision is the selection of alternative uses best suited to the planning area. The land use planning system, thus, inherently identifies activities which may minimize undesirable impacts and, consequently, minimizes the need for additional mitigating measures.

These field level trade-offs present a key opportunity for recognizing needed local constraints on coal leasing. The public would have an opportunity to comment on the lands identified as acceptable for consideration for leasing, and participate in the resources trade-off decisions.

In addition to the incorporation of specific criteria as guidance for individual land use planning decisions, the preferred program includes another new and major mitigation element, which assures that mitigation is a priority element in final tract selection decisions. This process requires the ranking of those tracts which could be leased within a region so that the consequences of selecting specific tracts for development can be compared, both within a particular region and among regions.

The process recognizes that because of the probability that, in many regions, there will be more Federal coal that could be leased than would be necessary to lease, the Department has a responsibility to select, from among those coal lands which are not excluded from leasing through application of unsuitability standards or other resource management decisions, those tracts whose development would cause the least environmental, social, and economic damage. This means that mitigation will take place even in those areas where both the application of laws and standards and the exercise of the resource manager's judgement have led to decisions that other resource values must be subordinated to the need for the leasing and mining of Federally owned coal.

The ranking process also provides the most effective opportunity for consideration of social and economic consequences of Federal coal management. The Department, while recognizing its responsibility in this important area, also recognizes that social and economic values, problems, and mitigation measures can not be categorized, evaluated, and implemented through a process of criteria and standards in a Federal resource management program. Because the ranking process is less a reflection of law and standards, and more a reflection of judgement and discretion, it is better suited to the evaluation of local and regional social and economic considerations. These considerations are to receive priority, along with identification of environmental consequences, in the ranking process included in the preferred Federal coal management program and several other alternatives.

The impacts of developing a specific tract, and the cumulative and interdependent impacts which would result

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from developing groups of tracts, would be considered in selecting those tracts to be offered for sale. By ranking and comparing all tracts within a region, rather than ranking only those tracts in geographically smaller individual planning areas, and by considering how the timing of tract development could influence the amount or kind of impacts, the Department would be able to select for leasing those tracts which have the least adverse cumulative environmental, social, and economic impacts.

Other significant mitigation measures in the preferred program and several of the alternatives are set out below:

- By providing for extensive public participation and special opportunities for the states to take part in the leasing process from land use planning through lease sale and beyond, the Department would seek to ensure that the local and regional publics and their representatives—those most knowledgeable about local and regional conditions—will always be well represented in leasing decisions. The careful consideration of the views of the states and the comments of the public before major leasing decisions are made would serve to mitigate adverse local and regional impacts of coal development.
- The procedure for setting regional production goals ensures that the need for coal leasing would be continually reassessed, thus avoiding the leasing of an unnecessarily large number of tracts. Too large a number of leased tracts would diminish the ability of state and local governments to plan with an adequate degree of accuracy to mitigate social and economic impacts of coal development. The leasing of an excess number of tracts also would diminish the effectiveness of the ranking process, require the selection of additional less desirable tracts, and increase local uncertainty about the potential environmental consequences of leasing.
- The manner in which requirements of the National Environmental Policy Act of 1969 would be complied with in the preferred program and alternatives would further serve to identify adverse impacts and the opportunities for mitigation. National and inter-regional impacts of Federal coal management decisions, described in this statement, would be carefully monitored by the Department and considered in supplements to this statement if required. Environmental impact statements considering the impacts of proposed lease sales for four-year periods within specific coal production regions would be prepared. These statements would examine the cumulative environmental impacts of coal development on a region-wide basis, as well as consider the site-specific impacts of each tract to be offered for lease. The public participation opportunities provided during the environmental impact statement process would provide additional extensive opportunity for the public to assist the Department in assuring that decisions at every level of a Federal coal management program would fully consider environmental impacts and mitigation measures.
- The preferred definition of maximum economic recovery (MER) seeks to encourage the aggressive removal of coal from Federal leases. Coal which is considered marginally sub-economic under current practices would, under the preferred program, likely be included in coal production from the lease. To make removal of these deposits possible without unfair economic hardships on the mine operator, the Department would give up some of the bonus bid it might otherwise require for a lease where the MER determination indicates that the trade-off is for the long-term benefit of the public, considering all environmental and social factors bearing on the tract. This approach to MER would in the long run lessen the area disturbed by mining and decrease the possibility of second mine openings over the same area.
- The Secretary has also indicated that the Department should be responsible for determining, with reasonable certainty, that a specific tract can be developed without severe or permanent harm to the environment and for determining the stipulations needed to ensure this protection prior to the lease sale, rather than waiting to make this determination at the mining plan stage. This requires that the Federal coal management program have adequate environmental data available for tract ranking and selection prior to the decision to lease. Site-specific analysis of each tract would be conducted prior to ranking and an examination would be made for each selected tract to develop lease stipulations if necessary. Where appropriate, additional detailed, site-specific conditions would be imposed in the mining permit issued upon approval of the mining plan.
- The Secretary would require, under the preferred program and several other alternatives, that unsuitability criteria and general land use trade-off decisions be applied not only to new competitive leasing, but also to existing, nonproducing leases, emergency leases, and noncompetitive leases. Appropriate action would be taken where noncompliance is found. This element of the program would help bring consistent mitigation to those lands which could be affected by development of the more than 500 outstanding leases and more than 200 preference right lease applications.
- The Department's Energy Minerals Rehabilitation Inventory and Analysis Program (EMRIA) would provide site-specific reclamation data for use at the several decision points in the preferred program and several other alternatives. EMRIA, begun in 1975, entails inventory and analysis of rehabilitation capability of lands having potential for Federal coal development. Soils, overburden, surface and groundwater, as well as revegetation characteristics are analyzed so that prescriptions for reclamation can be developed.

While this discussion has given emphasis to those mitigation measures which prevent or minimize damage by prohibiting, restricting, or directing the relocation of prospective Federal coal leasing, it should be noted that most

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of the mitigation measures built into the preferred program and several other alternatives are designed to assure that when Federal coal leasing and resultant mining take place, both the damage and the benefits from coal development are considered, and are managed in a way that will minimize environmental and social disruption.

The key measures mitigating the physical environmental consequences of coal mining are contained in the Surface Mining Control and Reclamation Act of 1977. In general, the law requires pre-mining permit application and reclamation planning; the application of standards for the conduct of mining which relate to the environmental effects of the mine operation, on and off the mine site, as well as to public health and safety; state or Federal processes for designating lands as unsuitable for mining; and adoption of State laws and regulations for enforcement of regulatory programs which meet minimum Federal standards. The Act also applies these standards and processes to the surface effects of underground mining.

These mitigation measures are described in detail in the Draft Environmental Statement on the Proposed Final Regulations of the Office of Surface Mining [1].

Additional environmental mitigation measures, based on other laws and on the Department's broad resource management responsibility and authority, are included for consideration in the ranking process described in this statement.

6.3 MITIGATION OF SOCIOECONOMIC IMPACTS

Many of the most serious problems associated with coal leasing involve the ancillary social and economic effects of development. In rural areas, coal development has induced wholesale change in the social and economic structures of numerous isolated communities. While the change offers long-term opportunities for the communities in question, short-term distress has too often been the more visible result. The mitigation of the socioeconomic impacts of coal development presents special problems for the Department, since its statutory authorities and responsibilities are far more limited than the scope of the problems. For the time being, the Department's chief response must be improved coordination and consultation with local and state governments, as provided in the preferred program and several other alternatives.

6.3.1 General Socioeconomic Impact Mitigation

Impact assistance is a policy question of independent national significance. In March 1978, an intergovernmental Energy Impact Assistance Steering Group completed the *Report to the President: Energy Impact Assistance*, which examined the nature of adverse impacts, gaps in existing mitigation mechanisms, and a broad range of program options [2]. The Report's treatment of these problems is instructive for this statement and recommended generally as a reference.

According to the Report, the fundamental cause of social and economic impacts is rapid economic growth. While the dimensions of growth problems in a given locale vary substantially (see 6.3.2), a number of problems seem to recur frequently. The location of most Federal coal is in isolated

rural areas of the West. Since the location of the coal resource determines the sites of the economic activity, once a development site has been chosen, there is commonly little choice but to stimulate rapid growth in isolated rural areas, where the new activity is disproportionately large in relation to the existing economic base. There are frequently difficulties with taxation systems which do not target tax resources to impacts, which were designed to suit an agricultural economy, or which do not coincide with the boundaries of economic activity. Much of the labor force for the Decker mine in Montana, for example, lives in Sheridan, Wyoming, even though the mine produces revenues for Montana. Finally, all of the impact problems are exacerbated by uncertainty, which weakens both individual and institutional accommodations to change. The Report found five leading categories of the resulting impact:

- Public facility and service deficiencies or shortages.
- Commercial facility and professional services deficiencies and shortages.
- Housing shortages and housing price inflation.
- Social disruption.
- Transportation impacts.

The Report focused its analysis on five specific categories of gaps in existing mechanisms:

1. Information – timely and accurate information regarding the development is commonly unavailable.
2. State/local/tribal participation in the decision-making process—the inability of these institutions to participate early on in decisions regarding timing, location, and scope of development.
3. Planning and management – inadequate state, local and area-wide institutional capacity.
4. Coordination of assistance mechanisms – the imprecise targeting of existing Federal programs to impact problems.
5. Financing – the difficulty that impacted communities have in securing access to normal financing mechanisms.

The preferred program and several alternatives would attempt to close the first two of these five gaps. The others are not within the Department's direct jurisdiction, but through cooperation with other Federal agencies and with state and local governments, the Department can help make the total effort to mitigate social and economic impacts more effective.

In addition to mitigation of social and economic problems common to all rural areas affected by sudden and large-scale industrial growth, priority is given in the Department's preferred program and several other alternatives for mitigation to protect those agricultural communities which, in the western states where Federal coal is most abundant, are dependent on sound management of grasslands, watersheds, and other resources which serve as the foundation for extensive livestock grazing and other agricultural enterprises. Mitigation of impacts on agricultural economies is not limited to management measures designed to permit livestock and crop production to expand while coal production increases. A principal element of the preferred program and several other alternatives is consideration, throughout the decision process, of measures to assure that individuals and families on ranches and farms, as well as the communities and the resources which support individual agricultural enterprises, are not damaged or disrupted.

MITIGATION OF MAJOR ADVERSE IMPACTS

It should be emphasized that mitigation also includes measures to assure that the potential benefits of coal development are recognized, and the effect of the distribution of these benefits considered, when decisions are made about management of Federal coal. So, while the preferred program and several other alternatives would operate to protect resources and people from damage, they would also be capable of determining how the distribution of benefits have affected those same people and resources. With information made available from community leaders, tribal officials, state and local governments, and individuals, Federal coal leasing decisions can reinforce the community development and economic plans of citizens in those areas where Federal coal is located.

Guidance provided to the Department's resource managers and other planners by the Report includes identification of nine principal factors that should be considered when evaluating the impacts of proposed decisions:

- Avoidance - the extent to which the occurrence of adverse socioeconomic impacts due to energy development can be minimized, if not averted altogether, in the early stages of the energy development process.
- Closing Policy Gaps - the degree to which the process for formulating energy development policy and making key energy facility siting decisions provides adequate opportunity for participation by appropriate state, local and tribal governments; also, the extent to which provisions exist for the preparation and early consideration of impact assessment data.
- Closing Resource Gaps - the degree to which proposed policies or program strategies reduce the inadequacies found to exist among existing Federal, state, local, and industry financial assistance mechanisms available to impacted areas.
- Barriers to Implementation - special organizational, administrative, or legislative steps which must be taken and the time required to effect proposed actions.
- Risk Sharing - the manner in which the consequences (e.g. higher costs, potential loss of sunk costs and future revenues from project failure, high interest payments, and other costs) of uncertainty characteristic of energy-related growth are borne by the participants in the energy development process - i.e., Federal, state, local, and tribal governments and industry.
- Cost Internalization - the extent to which the costs of addressing adverse impacts resulting from energy development are borne by the producing company or passed through in energy product processes to energy consumers.
- Impact on Federal, State, Local, and Tribal Budgets - the degree to which proposed policies and actions will increase or decrease the amount of Federal, state, local, and/or tribal funds required for impact assistance programs.
- Enhanced State, Local, and Tribal Capacity - the manner in which authorities, resources, and capabilities of State, local and tribal governments for

addressing the problems faced by energy-impacted communities are increased.

- Leverage on Industry Participation and Mitigation - the degree to which the role of industry as a participant in avoiding and/or ameliorating the adverse socioeconomic effects resulting from its energy development activities is increased.

The program recommendations of the Report led to modifications in Senator Hart's S. 1493, a broad-based inland energy impact assistance bill. This proposal did not pass in the 95th Congress.

Legislation providing a more modest impact authority for the Farmer's Home Administration did pass, as section 601 of the Powerplant and Industrial Fuels Use Act of 1978. This authority for both planning and construction assistance will be implemented by the Secretary of Agriculture, in consultation with the Secretaries of Energy and Labor. Funds, in the form of grants to the states, local governments, and tribal councils, are available under the program to support planning, land acquisition, and development. Coal companies within designated impact areas will be required to report to the Secretary of Energy on request by the state Governor on mine employment and related matters for the coming three years.

The Secretary of the Interior is a member of the interagency committee created by Section 746 of the Act. The function of the committee is to conduct a study of the socioeconomic impacts of expanded coal production and rapid energy development in general, on states, including local communities, and on the public. The committee is required to study the adequacy of housing and public recreational and cultural facilities for coal miners and their families, and the effect of any Federal and state laws or regulations on providing such housing and facilities.

The Secretary of the Interior also participates in another study required by the Act (sec. 742 (c)), which is required to evaluate the economic and social impacts on coal-producing counties and states of present and prospective land ownership patterns and levels of income, property, severance, and other taxes paid by coal producers.

6.3.2 Program Socioeconomic Impact Mitigation

One effect of the preferred program and several other alternatives will be to decentralize decisions regarding social and economic impacts. Because of regional and local variations in these impact problems, an aggregate estimate of impacts is inherently misleading, since the mitigation response must take place on a decentralized basis, taking into account the unique aspects of each impact situation. The aggregate perspective is, therefore, not as important as a consideration of the range of potential problems. For this reason, this section addresses nine factors which illustrate the dimensions of impact variation, and hence the varying requirements for mitigation which the land management planning system must face.

6.3.2.1 Physical Characteristics. The physical characteristics of the impacted areas-topography, quantity and quality of available water, soil, and climate-have an important effect on the cost of both public infrastructure (water and sewer systems, streets) and private infrastructure (residential and

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commercial construction). For example, site preparation costs in West Virginia typically run much higher than in the West, due to the terrain. The steep slopes and narrow valleys in much of West Virginia also increase the problems of environmental hazards from siltation, slides, and flooding, and so require special mitigation measures that would not be so important in flatter country. Gillette, Wyoming, has different problems resulting from physical characteristics of its area. The sources of available potable surface and groundwater are many miles away from town, and the nearby groundwater requires extensive treatment before it can be used for municipal purposes. Either way, the cost of providing water in Gillette significantly exceeds the national average for per capita expenditures.

6.3.2.2 Economic Structure. Pre-existing economic conditions influence the path of the new economic stimulus provided by energy development. One such condition is the local labor market. If the local economy has a surplus of labor prior to the onset of development, the development will tend to absorb local workers and the change in population will be less than where no surplus exists. Research in the West has shown that the population change attributable to similar energy projects can vary by as much as fifty percent. At the same time, labor market conditions shift rapidly. For example, many of the high unemployment conditions that existed in southern West Virginia no longer exist—and there are thousands of new jobs to be created in the near future. Finally, since the prevailing unemployment rate is no indicator of the availability of specialized labor, a thorough knowledge of an incoming industry's requirements may be necessary to accurately predict local population growth.

A second significant pre-existing condition is the pattern of population and service centers. Isolated communities are more likely to feel the effects of impacts than communities with services available nearby.

Finally, the nature and extent of local impacts will be affected by conditions in other local base industries. For example, the mid-1970's boom of Rock Springs, Wyoming, was caused by a combination of energy and non-energy projects increasing their employment at the same time. Oil and gas development and increased uranium mining will cause similar additional boom pressures on several western coal regions in the 1980's.

6.3.2.3 Legal Framework. The legal framework within which local governments operate also affects the role that they can play in solving impact problems. Local governments are the legal entities of the states in which they are located, and the powers given them to raise and spend revenue, as well as to regulate land use and other matters, vary significantly from one state to another. Similarly, the state resources available to solve impact problems differ significantly from one state to another. Most western states now have some form of state funding available for impacts.

6.3.2.4 The Project. Different types of projects produce significantly different sorts of stresses on the impacted community. The labor requirements associated with the construction and extraction phases of individual technologies vary markedly, and are the chief cause of these differences.

The policies of contractors or subcontractors regarding rotations and the provision of housing facilities may also affect impacts. Experience with the Alaska pipeline demonstrated that a thirty-day work rotation attracted workers from the lower 48 states; a ten-day work rotation attracted Alaskans from Fairbanks; and a five-to-seven-day work rotation attracted Alaska natives to the work force. The varying composition of the work force induced by these policies can act as a surrogate for labor market conditions.

6.3.2.5 Community Attitudes. A community's values and goals affect the nature of impacts by setting priorities for the provision of public services. It is not uncommon to find a community insisting on an increase in medical services when other demands are more immediate. The attitudes of the community also affect impacts by influencing the political choices that an impacted community makes. One example is the exercise of the police power; certain kinds of land use control may not be acceptable in a rural community.

6.3.2.6 Pace of Development. The faster the growth rate, the more likely the growth will produce stresses which generate impacts. Clearly, one thousand new jobs introduced into a small community over five years will have a less damaging effect on that community than would the introduction of the same number of new jobs within a six month period. The pace of development is similar to uncertainty, in that it tends to aggravate other difficulties.

6.3.2.7 Existing Infrastructure Commitments. Excess capacity in a specific category of public facilities will clearly aid a community in meeting development impacts, and may naturally affect the communities' overall perception of the impact problem. This excess or flexible capacity may include administrative services as well as public facilities. Appalachian communities, served by substate planning districts supported for years by the Economic Development Administration and the Appalachian Regional Commission, will be less likely to need certain kinds of rudimentary technical support than western communities. The demand for this technical support has in fact been far greater in the West than in the East, or in the coastal zone.

Infrastructure commitments may also have a negative side. For example, water and sewer projects proposed in Raleigh County, West Virginia, provoked unfavorable reactions from pensioners already served by septic tanks. A new water and sewer network might only be financially feasible if it serves all, but user charges impose substantial hardships on established residents with fixed incomes.

6.3.2.8 Overall Population Density. Population density affects the choices available for mitigation measures. Sweetwater County, Wyoming, is substantially larger than New Jersey and, prior to impact, was populated by approximately two persons per square mile; its population has now doubled. This will affect the design of a long-term approach to impact problems.

A sparse population may also affect the share of state and Federal resources directed to a locality, due to formula allocations and lack of political strength.

Providing an appropriate mitigation response to social and economic impacts is a complex institutional problem.

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Local governments address impact problems with choices to regulate or to finance improvements and operations, although these choices may be legally or practically limited. State governments affect impact problems through regulatory agencies (land use, facility siting, environmental control, etc.), through state-financed impact relief, and through Federal programs administered by the states. The Federal government offers an additional structure of regulation and financial support, and the private sector may provide its own resources to address certain impact problems.

The Department's role in this complex picture is, of necessity, limited. The most profound limitation is on its capacity to target direct financial assistance for planning, strengthening institutional capacity, operations, or capital improvements. Under section 35 of the Mineral Leasing Act of 1920, as amended by section 317(a) of the Federal Land Policy and Management Act of 1976, fifty percent of mineral leasing royalties, rentals, bonuses, and fee sales are returned directly to the states, to be distributed according to state law. In spending those funds, the states are directed to give priority to those subdivisions of the state socially or economically impacted by development of minerals under the Mineral Leasing Act. The funds are to be used for planning, construction and maintenance of public facilities, and provision of public service.

A loan program for impacted areas, secured by future royalties, has not been implemented. This program was established under section 317(c) of the Federal Land Policy and Management Act. All loans would bear an interest rate comparable to the best rates available in the municipal bond market. The loans are limited to 55 percent of the anticipated mineral revenues due a state for the following 10-year period. The Department has circulated proposed regulations for this loan program (43 CFR 1880) setting out procedures under which the loans may be made. Thus far, funds have not been appropriated for this program.

An important social and economic impact mitigation feature of the Department's preferred program and several other alternatives is the emergency leasing program. This program is provided in large part specifically to avoid the hardships of sudden mine closings. Of concern is not only the unemployment caused directly by such closings, and the consequent disruption of lives, but also the underemployment of still usable community facilities and services that might have to be replaced elsewhere if production were satisfied through development of new mines in previously undeveloped areas. The Department does not have the authority to directly influence the decisions of the Federal, state, local, or private entities who might provide impact funding. The Department cannot, for example, significantly affect use of the Economic Development Administration's Title IX program. The Department cannot dictate priorities to such state agencies as Montana's Coal Board. Nor can the Department appropriately play a role in persuading a local government to pass a bond issue for needed improvements. Finally, it does not appear to be legally possible for the Department to require private financial assistance through requirements in lease stipulations. The task of providing mitigation rests primarily with states. The Department is required by section 522 of the Surface Mining Control and Reclamation Act of 1977 and section 202 of the Federal Land Policy and Management Act

of 1976 to coordinate with and to consider state and local land use and management resource programs in its own general planning processes. Two of the unsuitability criteria: the buffering of state lands unsuitable and state nominations of additional criteria, are directed at fostering this coordination. Additionally, criteria on historic land and sites, natural areas, state listed endangered species, municipal watersheds, state resident fish and wildlife, and national resource waters provide for direct state or local participation. Indeed, the Department is not in a strong position to substantially affect most of the factors discussed in section 6.3.2—physical characteristics, economic structure, local leadership, legal framework, community attitudes, existing infrastructure commitments, or overall population density. What the Department can do is influence, and in some cases determine, the location, timing, and nature of development. Instead of providing a response after the commitment to development is made, the Department's authority must focus on the decisions that surround the initial commitment to proceed. Impacts on an area following mine closings must also be considered. Mine openings might be spaced out over time to avoid sharp changes in employment levels. The Department, thus, can play an effective role in planning tract sales to minimize or avert impacts at early stages of the development process. The Department will rely on comments from the state and local governments as a prime source of information in determining where avoidance of an area is warranted because of social or economic impacts. Further, the Department can effectively work to close four of the five gaps in existing mitigation mechanisms which were identified in the Report.

- Information – The Department could make all information generated in the coal management program which is not proprietary available to state and local governments as promptly as possible and could use lease stipulations to ensure disclosure of timely and accurate private sector information, and to ensure consultation of the private sector with affected governments.
- State/local/Tribal participation in Decisionmaking Process — The Department is ideally situated to consult with and examine development consequences with affected state and local governments prior to making decisions that might unduly burden these governments with undesirable or unmanageable responsibilities for development impacts.
- Planning and Management – Despite the inability of the Department to provide additional direct financial assistance, state, local, and areawide institutional capacity could be stimulated by timely and consistent Departmental efforts to jointly consider development consequences.
- Coordination of Assistance Mechanisms – While the Department has no direct authority to influence other Federal programs, timely and consistent consultation with other agencies might indirectly affect program priorities.

The preferred program and several other alternatives would provide for and, in fact, emphasize each of the Departmental responses suggested above. Particularly important are the early, frequent, and special access procedures for state government designed into all significant

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steps of the preferred program and several other alternatives and the special focus given to consultation with state governments on the location and timing of lease sales.

In sum, the sensitivity of the land use and activity planning processes assume particular importance for mitigating social and economic impacts. A sensitivity to the social and economic consequences of development presents difficult challenges to the planning system, since the optimum management of Federal resources for strictly Federal purposes may produce intolerable consequences for non-Federal governments. This may ultimately prove the strongest basis for adopting the preferred program and proceeding with

renewed coal leasing, since renewed coal leasing offers the opportunity to modify the spatial pattern of coal development in response to such policy concerns.

6.4 REFERENCES

1. U.S. Department of the Interior, Office of Surface Mining and Reclamation, 1978. Proposed Final Regulations of the Office of Surface Mining. Washington, D.C.
2. Energy Impact Assistance Steering Group, 1978. Report to the President: Energy Impact Assistance. Washington, D.C.

CHAPTER 7

LONG-TERM ENVIRONMENTAL CONSEQUENCES OF THE FEDERAL COAL MANAGEMENT PROGRAM

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CHAPTER 7

LONG-TERM ENVIRONMENTAL CONSEQUENCES OF FEDERAL COAL MANAGEMENT PROGRAM ALTERNATIVES

This chapter presents long-term environmental consequences of the Federal coal management program alternatives. Adverse impacts which cannot be avoided are described in Section 7.1. Section 7.2 discusses irreversible and irretrievable commitments of public resources required to support the alternatives. Section 7.3 addresses losses of long-term productivity versus short-term uses of public lands. Unless otherwise noted, the discussion in these sections is in the context of the preferred Federal coal management program. In deriving the impacts in Chapter 5, all mitigating measures required by law or regulation in a coal management program were considered to be in operation. Thus, the impacts described in that chapter can be considered as those unavoidable under the various program alternatives. This chapter is largely a summary of the material presented there, highlighting the results that need to be considered under long-term environmental consequences. Nearly all the effects discussed here are subject to some form of control, and usually control to be attempted both in the leasing and post-leasing program structures; however, no control program, however carefully designed, is perfect, and, inevitably, some of these effects will be observed in the environment.

7.1 UNAVOIDABLE ADVERSE IMPACTS

During all activities associated with the coal cycle (exploration, mining, beneficiation, transportation, conversion, and use), programmatic measures would be in operation to mitigate potentially adverse environmental impacts. Nevertheless, it is expected that there would be certain adverse impacts which could not be avoided regardless of the level or types of mitigation employed. This section provides a qualitative discussion of these unavoidable effects. To prevent considerable repetition, the effects are discussed on a general basis with significant regional differences identified where appropriate.

7.1.1 Physical Environment

7.1.1.1 Topography. Topographical features would be unavoidably altered by construction and mining. Construction activities could result in the filling of areas of low relief, the leveling of rolling terrain, and the removal of prominent points of land. In addition, construction of water impoundments would result in the inundation of large areas of land and would completely alter the topography of such areas. Such impoundments are regulated under the Surface Mining Control and Reclamation Act of 1977, but will still result in residual effects on topography. Mining activities, especially surface mining, would result in the disturbance of extensive surface areas. Reclamation would, to a large extent, restore the topography to approximate pre-mining contours in many

areas. Subsidence of land would also unavoidably result from some underground mining activities.

7.1.1.2 Soil. Due to the nature of surface mining, and to a lesser extent underground mining, some quantities of native topsoils would be mixed with or buried under mining wastes or lost through erosion. These soils constitute a valuable natural resource which would be irrevocably lost. The Surface Mining Control and Reclamation Act contains several provisions designed to control and minimize the soil loss. With reclamation, new soils would form over time; however, in some areas of the West, particularly the more arid regions, hundreds of years could be required for natural processes to reestablish fertile soils.

7.1.1.3 Archaeological and Historical Resources. Even though coal production activities are accomplished within the framework of existing protective laws and regulations, there would be some loss of archaeological, cultural and historic resources within each coal region. In no case, however, should this loss involve a significant site or a significant assemblage of sites if strict enforcement of statutory requirements and application of unsuitability criteria and other elements of the preferred program and alternatives are maintained. Moreover, surveys required under existing regulations could add to the cultural resources data base.

7.1.1.4 Paleontological Resources. Coal deposits and overburden material inevitably contain fossil remains. Although significant fossil remains could be lost through mining and mine-related activities, the number and amount of such losses would be minimized by the imposition of recovery stipulations. Criteria and guidelines for protection and recovery of such resources are presently being developed. It is not possible to meaningfully estimate the extent of potential loss of this nonrenewable resource.

7.1.1.5 Water Resources. Water would be required for coal mining in all of the coal regions; additional water would be required for developments of supporting activities and the population associated with coal mining, conversion, and use. In water-short regions, the large volumes of water withdrawn for coal development could be available for agricultural, industrial, commercial, and residential uses. Generally, however, much of this water would re-enter the water regime and be available for such other uses. If coal production were accompanied by development of power plants, gasification plants, or other conversion facilities, consumptive water uses and conflicts with other users would increase. Water exists in sufficient quantities in the three Appalachian Coal Regions and the Eastern Interior Coal Region to support coal development; however, water quality can be of concern. In the

Western Interior, Texas, San Juan River, Uinta-Southwestern Utah, Fort Union, Green River-Hams Fork, and Powder River Regions, sufficient water would generally be available on an annual basis, though shortages might occur during the predictable and regular low flow periods or under drought conditions. In the Denver-Raton Mesa Coal Region, water might not be available, even on an annual basis, to support projected coal-related and other developmental activities.

Adverse impacts resulting from some breaching and draining of aquifers during coal mining could not be avoided. The loss of local aquifers can be quite important in the Powder River, Fort Union, and Texas Coal Regions. Here, lowering of water levels may dry up springs and seeps or reduce stream flows. Replacement of aquifers with material of differing water holding capabilities than those present prior to mining would disrupt groundwater flow patterns and could reduce aquifer storage capacity.

Disruption of existing surface drainage patterns and development of lakes and ponds could result from surface mining, especially where thick coal seams with thin overburden layers are mined. The Surface Mining Control and Reclamation Act specifically seeks to mitigate this effect. Water use in the area could be adversely affected to the extent that stream flow regimes would be changed by channel modifications. In addition, there could be an increased loss of water by evaporation from standing bodies of water.

Increased mining would also create a potential for some unavoidable degradation of local and regional water quality. Construction and mining activities would result in increased erosion, runoff, and sedimentation. Acid mine drainage could occur, primarily in the eastern coal regions. Alkaline mine drainage could occur in some western regions. The operation of coal conversion and utility plants would produce potential water pollutants including dissolved solids, ammonia, non-degradable organic compounds, oxygenated compounds, sulfur compounds, cyanides, phosphates, and trace elements. All of these effects are subject to controls. Even with controls, coal mining would pose some small risk of their occurring and polluting surface or groundwater. Consumptive uses could also increase salinity and concentrations of pollutants downstream from the point of diversion where the water had previously been diluting other sources of water pollution. Population associated with coal mines and conversion and mine-mouth plants would introduce increased salts, nutrients, organic materials, bacteria, fertilizers, pesticides, trace elements, heavy metals, etc., into surface waters, especially where they overtax existing sewage treatment facilities.

A general scenic degradation would occur as a result of coal mining, conversion, and use, though the unsuitability criteria on designated wild and scenic rivers and on visual resource areas are aimed at eliminating this possibility. Scenic rivers and other water related recreational activities could be adversely impacted. The waters themselves could be degraded or the land through which the water flows could be affected to such an extent that their aesthetic properties would be lost.

Since water is a renewable resource, short-term consumption to support coal mining should not greatly affect future availability. The construction of impoundments could result in locally increased reliability of water supplies. On the other hand, the removal of native topsoil could alter drainage patterns and render large surface areas impervious with the

result that groundwater levels and pressures would be lowered, thus reducing the future productivity of some aquifers. The use of large amounts of the available water supply during the active life of a mine in water-short regions could result in a significant shift in the local concentration of other water-using activities, most typically a decrease in irrigated agriculture in relation to urban and industrial water users. These shifts could outlive local coal mining and affect the long-term regional water use patterns.

Significant long-term changes would result from a decline in water quality resulting from coal development. The long-term quality of the available water supply would probably decline due to the discharge of industrial and municipal wastes, the increased sediment load from construction-related activities, possible return-flow effects, and changing consumptive patterns, including construction of impoundments. A reduction in water quality could result in restrictions upon the productive uses of surface water and groundwater. Decreased water quality would also have impacts on long-term biological productivity in streams and rivers.

7.1.1.6 Air Quality. Degradation of local air quality would unavoidably occur in all regions as a result of projected levels of 1985 and 1990 coal development under any of the alternatives. Some potential damage to plants, animals, and human health from air pollutants would be unavoidable. Some increases in sulfur oxides, nitrogen oxides, carbon monoxide, carbon dioxide, hydrocarbons, trace elements, and particulates would occur in all regions even though best available emission control technologies are employed and air quality standards are enforced.

7.1.2 Ecological Resources

Coal development would affect ecological systems through the unavoidable disruption of habitats, food chains, predator-prey relationships, behavior patterns, and various activities of species playing key roles in the ecosystem. The coal management program would go to great lengths to avoid these impacts. Several of the unsuitability criteria have as their purpose the avoidance of wildlife impacts. In addition, a very active wildlife program has been provided for, including participation by the U.S. Fish and Wildlife Service. Terrestrial ecosystems would be affected by land clearing activities, an increased presence of human activities in formerly remote areas, changes in air quality, and decreases in soil productivity. Aquatic ecosystems would be affected by changes in water quality, changes in stream hydrology, activities which dry up aquatic habitats, and the construction of reservoirs which would change river ecosystems to lake ecosystems.

Existing vegetation would be destroyed on sites used for mining, solid and liquid waste disposal, community expansion, and the developments of related activities. In addition, increased populations in presently undeveloped areas of the coal regions would intensify recreational activities on lands formerly not subject to intensive activities, resulting in destruction or reduction of wildlife and habitat. At mining sites, reclamation would restore vegetation to support former uses; however, all reclamation efforts would not likely be completely successful, especially on some severely disturbed

mine areas which have both low precipitation and infertile soil. Mining will not be allowed on lands that cannot be reclaimed because of physical limitations. In the drier areas of the West or in areas with high evapotranspiration rates, it is possible that many decades could pass before natural vegetation and soil conditions could be restored to disturbed areas, even with reclamation. Bonding is required to ensure reclamation activity will continue even after the active life of the mine. In the Appalachian Coal Regions, acid drainage could hinder revegetation efforts. Revegetation of an area may result in a plant species composition drastically different from that which existed prior to development if it is for a more beneficial use. Reclamation efforts, on the other hand, may attempt to restore the original use but with an entirely different mix of species. Either way, coal mining could have lasting effects on the ecology of the local area.

Loss of habitat and reductions in population would occur as unavoidable consequences during the mining and use of coal. Some displacement and mortality of animals would occur in all regions.

Mining, transportation, and processing of coal would expose wildlife to various hazards and disturbances. Blasting, construction, and other noises associated with the mining activity would be unavoidable and would frighten away some wildlife species. Reproductive and migratory behavior could be affected.

Destruction of existing aquatic habitat and fauna would occur where streams are altered by mining or by construction of reservoirs. Reduction of water quality as a result of development would also adversely affect aquatic life. For example, increased sedimentation of waters could result in the elimination of those species which require clean gravel for spawning. Changes to or elimination of ponds, streams, and potholes would also adversely affect waterfowl.

In many areas, wildlife would return both during and after reclamation efforts, providing adequate water sources are available. In most cases, however, the diversity, density, and composition of the new populations would be altered from previous conditions.

7.1.3 Community Resources

The influx of a relatively large number of people into a region as a result of coal development could exert a major influence upon the region; primarily, this growth affects existing communities located near the areas of development. The potential impacts to a community would depend upon the relative size and the rate of population increases, the existing infrastructure, and the adequacy of any advanced planning for growth. Other factors affecting community ability to absorb growth include past experience with growth phenomena and mining. There could be instances, however, where large and rapid increases in population would unavoidably create growth rates reaching "hyperurbanization" levels. This is particularly true in more rural western regions where existing base populations of communities are often small compared to the rapid increase in construction and operating work forces related to coal development. Furthermore, the western communities usually have had much less experience with coal mining and growth phenomena than have had the eastern regions.

Financing and construction of facilities for education, fire and police protection, housing, water and sewer distribution, and health-medical care delivery systems take considerable lead time and often these facilities cannot be developed rapidly enough to accommodate rapid population growth. Local governments may experience severe problems in raising the capital to expand necessary facilities and services, thus creating hardships for long-term residents as well as newcomers.

Shortages of housing and other facilities and services, combined with higher wages of industrial workers, could create inflationary trends most adversely affecting established residents, particularly those on fixed incomes. Hope for higher wages, may also lead to an influx of workers seeking employment opportunities in excess of available jobs. This would tend to increase unemployment in the area, placing additional burdens on social service systems and local taxpayers.

Most rural communities have well-defined and long-established networks of social and political relationships. It is likely that in such a community, these groups would be fragmented by the intrusion of relatively large numbers of persons who, in effect, would create a new social order. Even were this not to occur, conflicts would inevitably develop between the in-migrating construction and mine workers and the local population over differing personnel, economic, and social values. This could lead to an overall deterioration of the quality of life for everyone in the community.

The extent to which these conditions are unavoidable would be related to the size of the population influx compared to the size and stability of the base population of the given communities. Increases in most of the eastern regions such as the Appalachian Coal Regions may be incrementally small because of the existing high level of coal development there. Conversely, western regions could experience large population changes compared to their baseline levels. This is particularly true in the Powder River Coal Region and some of the other more rural areas of the West.

7.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF PUBLIC RESOURCES

Once coal is mined, it cannot be replaced. However, this is not the only coal that is lost. Some coal is not recoverable in the process of mining. An average of about 85 percent of the coal resource can be recovered when area surface mining methods are used. Only about half of the coal in underground mining can be recovered, especially when seams are thick. Basically, this is because coal must be left to support the ground above the seam being mined. The Department's policy on maximum economic recovery is meant to mitigate this effect.

Production of coal from Federal lands through 1977 totals about 448 million tons. An additional 15 to 50 percent of this production may have been lost in the mining process. In 1977 alone, coal production from Federal lands was 52 million tons, or nearly 12 percent of the total produced during the past 200 years.

Table 7-1 shows the amounts of projected coal production by regions for the various Federal coal

TABLE 7-1
COAL PRODUCTION SUMMARY^(a)
(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	176.0	208.3	211.7	217.5	208.4	211.6	216.7	211.8	211.7	210.4	211.5	211.1
Central Appalachian	206.8	202.7	205.5	178.8	202.7	204.4	175.9	205.6	204.8	192.5	203.4	211.0
Southern Appalachian	23.4	18.0	27.5	42.7	18.0	26.6	40.6	26.5	27.5	31.6	22.1	23.0
Eastern Interior	136.4	209.0	206.1	172.4	209.0	209.7	161.0	206.0	207.1	196.1	203.4	212.6
Western Interior	11.5	12.7	14.2	14.2	12.6	13.6	14.5	13.7	14.2	8.2	10.8	15.8
Texas	14.1	62.4	64.0	48.6	62.5	66.3	35.3	63.7	64.6	50.2	57.7	78.6
Other East	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL EAST	568.2	713.1	729.0	674.2	713.2	732.2	644.0	727.3	729.9	689.0	708.9	752.1
Powder River	37.4	150.0	204.8	275.0	150.0	205.0	300.0	205.0	205.0	225.0	204.6	183.7
Green River-Hams Fork	25.7	40.0	76.0	99.6	40.0	80.0	130.0	77.9	77.0	112.0	112.0	57.5
Fort Union	11.4	16.9	31.9	51.9	16.9	31.9	51.9	31.9	31.9	36.9	21.9	37.4
San Juan River	8.8	15.0	24.8	39.7	15.0	25.0	40.0	24.8	24.8	30.0	22.1	32.0
Uinta-Southwestern Utah	10.2	15.0	29.6	44.5	15.0	30.0	45.0	30.0	29.7	35.0	26.4	29.4
Denver-Raton Mesa	1.9	2.0	5.0	10.0	2.0	5.0	10.0	5.0	5.0	6.0	6.0	7.0
Other West	10.4	18.3	4.2	6.7	18.3	3.0	6.7	3.8	3.8	6.8	6.6	1.8
TOTAL WEST	105.8	257.2	376.3	527.4	257.2	379.9	583.6	378.4	377.2	451.7	399.6	348.8
TOTAL U.S.	674.0	970.4	1,105.3	1,201.6	970.4	1,112.1	1,227.6	1,105.7	1,107.1	1,140.7	1,108.5	1,100.9

TABLE 7-1 (Concluded)

COAL PRODUCTION SUMMARY

(million tons)

COAL REGIONS	1976	NO NEW LEASING			PREFERRED PROGRAM			PRLAs ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER- MINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1990 PROJECTIONS										
Northern Appalachian	176.0	193.8	219.4	261.5	193.8	220.1	252.8	219.4	219.6	217.8	222.3	225.3
Central Appalachian	206.8	191.3	211.2	237.8	191.2	206.2	217.6	210.5	210.0	203.0	205.5	225.4
Southern Appalachian	23.4	15.6	26.4	42.8	15.6	25.4	40.4	26.3	26.4	30.4	14.5	14.2
Eastern Interior	136.4	275.7	331.5	351.1	274.7	319.7	280.1	314.4	328.0	284.6	312.5	381.1
Western Interior	11.5	13.1	25.5	58.5	12.7	17.1	14.0	19.3	24.2	10.2	10.1	35.0
Texas	14.1	74.0	119.4	154.0	73.0	86.1	100.0	116.4	115.8	58.9	79.6	111.0
Other East	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL EAST	568.2	763.5	933.4	1105.7	761.0	874.6	904.9	906.3	924.0	804.9	844.5	992.0
Powder River	37.4	175.0	305.0	335.0	175.0	400.0	600.0	355.0	316.0	450.0	396.1	269.1
Green River-Hams Fork	25.7	66.5	98.7	119.0	70.0	120.0	175.0	101.0	104.2	150.0	149.5	62.8
Fort Union	11.4	21.9	51.0	94.9	21.9	41.9	81.9	47.4	50.6	51.9	22.5	54.4
San Juan River	8.8	25.0	59.4	77.3	25.0	50.0	75.0	54.9	58.4	60.0	57.7	63.0
Uinta-Southwestern Utah	10.2	19.8	45.0	65.0	20.0	40.0	60.0	42.0	44.8	50.0	28.3	36.8
Denver-Raton Mesa	1.9	5.0	10.7	15.0	5.0	10.0	15.0	10.5	10.6	10.0	7.5	10.3
Other West	10.4	14.4	10.3	7.7	14.4	10.7	9.1	8.6	10.2	3.7	8.3	14.1
TOTAL WEST	105.8	327.6	580.1	713.9	331.3	672.6	1016.0	619.4	594.8	775.6	669.9	510.5
TOTAL UNITED STATES	674.0	1091.1	1513.5	1819.6	1092.3	1547.2	1920.9	1525.7	1518.8	1580.5	1514.4	1502.5

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management program alternatives. Under a high coal production projection for the preferred program, for example, approximately 1.2 and 1.9 billion tons of coal would be mined in the years 1985 and 1990, respectively. An additional amount of coal, roughly about 600 and 940 million tons, respectively, would not be recoverable using current mining methods. Less coal will be lost with the Federal program in place than without it because of imposition of the maximum economic recovery requirement and emergency leasing.

As noted in Section 7.1.1.5, those aquifers drastically disturbed during mining or groundwater use may be irreversibly changed. Additionally, if large quantities of groundwater were to be pumped from thick aquifers, irreversible ground subsidence could occur, including compaction of the underlying aquifer. The quality of water in some aquifers could be irreversibly changed as, for example, when pumping of high quality water permits infiltration by lower quality water. Leachates from solid and liquid wastes of coal facilities could also cause irreversible changes to groundwater quality.

The other principal changes would be:

- Some drainage patterns would be irreversibly changed by mining and construction activities. Changes in drainage could lead to irreversible alterations to surface water hydrology.
- Fuels, electric power, lubricants, explosives, structural materials, capital, and manpower committed for coal development would be irretrievably lost to other uses.
- On those areas reclaimed to premining vegetation, it is doubtful that total reestablishment of the native plant communities to the same level of diversity would be initially possible. The number of exotic species may increase, at least initially and during the early phases of reclamation.
- A considerable portion of land use changes accompanying coal mining would be permanent since areas shifted to industrial and residential uses would likely remain committed to these uses.
- Where crop, grazing, and forest lands could not be restored to former productivity, there would be an irretrievable loss of productive capacity.
- Unidentified historical, archaeological, and paleontological sites would be destroyed by mining and construction activities and irretrievably lost.
- Less tangible values that would be irretrievably lost include areas of natural beauty and those of unique geologic significance as study sites.

7.3 LONG-TERM PRODUCTIVITY LOSSES VERSUS SHORT-TERM USE OF LANDS

7.3.1 Trade-Off Analysis of Multiple Uses of Public Lands

Agricultural productivity losses would be incurred with development of coal resources. This is true of all regions, but is of particular concern in the Eastern Interior and Western Interior Coal Regions. Development of Federal coal will tend to shift production from these regions. Estimates of the

agricultural productivity losses anticipated as a result of coal mining are presented in Table 7-2.

Many changes would be associated with the development of coal resources, and, in particular, surface mining, due primarily to the long-term nature of the land alteration. In many past instances, the productive capacity of land has been essentially destroyed through the employment of ecologically unsound mining practices. Further, there is insufficient experience in restoring lands to allow reasonable estimates to be made of the productivity that would be expected over the long term on reclaimed lands. The Surface Mining Control and Reclamation Act requires that reclamation efforts return the area to at least its former level of use.

Adjustments in the social structure of many communities will be needed as a result of coal development. These include adjusting to new social situations and living with people whose habits and values are different from those previously encountered. There may be frustrations, problems, and reductions in social welfare for both newcomers and long-time residents in the coal development areas. Prediction of the intensity and persistence of this social disruption or its consequences is not possible in a programmatic environmental impact statement.

7.3.2 Time Frame of Coal Leasing

The present Federal coal management program diligence requirements set exhaustion of new logical mining unit reserves within a 40-year period. The average mine is actively in production for about 30 years. Other time dependent elements of the program include:

- Production starts - within 10 years of lease.
- Initial lease term - 20 years.
- Lease renewal term - 10 years.

The management program as presently structured represents a long-term commitment of resources, e.g. 30-40 years. However, not all of the area of a lease is removed from other productive uses. For a surface mine, only a minor part might be actively mined at any one time. Disturbed lands generally enter the reclamation cycle simultaneously with active mining and can be available for other productive uses before shutdown of production. The only exception would be areas committed to long-term use such as building sites, roads, storage facilities, etc. Where areas are reclaimed soon after use, the time for alternative uses foregone and productivity losses experienced typically ranges between 5 and 10 years. Under the new surface mining regulations, mines will find it to their advantage to reclaim disturbed areas quickly.

7.3.3 Productivity

Reclamation efforts and natural revegetation of strip-mined areas would be initiated once the coal resource has been removed. Areas around buildings and other coal development related facilities would likely be revegetated and landscaped once construction of these structures was completed.

In Chapter 5, impacts to natural and agricultural productivities due to land disturbances were presented based on total commitment of land between 1976 and 1990. Land not committed to permanent structures or hard surfaces, and all strip-mined land is assumed to be potentially reclaimable,

TABLE 7-2

AGRICULTURAL PRODUCTIVITY VALUES,
COMPARISON OF ALTERNATIVES^a
(thousands of 1974 dollars)

REGION	NO NEW LEASING			PREFERRED PROGRAM			PRLA'S ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1985 PROJECTIONS											
Northern Appalachian	5170	5073	5238	1	-1	-12	-141	-142	-151	-2	-146
Central Appalachian	1012	1086	1014	0	-7	-16	-3	-5	-43	-9	-13
Southern Appalachian	1249	1712	1787	0	-35	-6	-28	-24	48	-90	-54
Eastern Interior	20806	20997	20630	0	108	-199	-42	1	-161	-511	87
Western Interior	5389	6648	6822	-3	-272	450	-351	-304	-398	2	978
Texas	1652	2289	2186	2	25	-179	-17	-3	-130	-55	150
Powder River	19	23	30	0	0	2	0	0	2	0	-2
Green River-Hams Fork	35	58	71	0	3	17	1	1	21	21	-10
Fort Union	221	265	473	-19	20	3	20	20	47	-30	50
San Juan River	1	2	3	0	0	0	0	0	0	0	0
Uinta-Southwestern Utah	4	4	5	0	0	0	0	0	0	0	0
Denver-Raton Mesa	171	228	279	0	10	5	8	9	35	55	14
1990 PROJECTIONS											
Northern Appalachian	2397	2758	4000	35	4	57	-1	0	-5	11	17
Central Appalachian	536	642	727	0	-6	-6	7	-1	-3	-8	7
Southern Appalachian	599	913	1170	0	-3	69	8	1	15	-31	-43
Eastern Interior	10482	11336	12598	0	-141	2	-116	-85	-150	-344	439
Western Interior	2717	5249	6265	-1	-134	-471	-201	-128	-88	-145	-162
Texas	1039	2109	2350	-6	-127	-193	-38	8	-255	-161	-54
Powder River	12	18	18	0	4	12	2	0	6	4	-2
Green River-Hams Fork	26	35	40	1	6	17	0	1	14	14	-1
Fort Union	162	269	356	0	-16	22	-3	3	14	-69	11
San Juan River	1	2	3	0	0	0	0	0	0	0	0
Uinta-Southwestern Utah	2	2	3	0	0	0	0	0	0	0	0
Denver-Raton Mesa	134	177	204	0	0	19	-3	-3	11	1	-10

^a Agricultural productivity values were calculated by multiplying the percent of total Land Disturbed (Section 5.2.2.1) devoted to cropland times an average value of all agricultural products sold per acre of land (Appendix H, Section H-6). Positive numbers represent greater productivity loss compared to the No New Leasing Alternative.

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and in some stage of reclamation. For purposes of the analysis, it was assumed that reclaimed land would be returned to natural or agricultural uses, specifically forest, range, or cropland, and not used for urban buildings or other development. Actual final land uses of reclaimed land will be dependent upon post-mining plans and are unknown at this time.

Estimates of the number of acres which will be in some stage of reclamation by the end of 1990, and the amounts allocated to either forest, range, or cropland (by crop) for the preferred alternative, mid-level production, are given in Table 7-3. Estimates of final potential productivity for various crops under the crop allocation are given in Table 7-4.

Reclamation to forest in the Appalachian and Eastern Interior Coal Regions would take between 25 and 30 years for coniferous species and between 75 and 80 years for hardwoods, based on present silvicultural techniques [1]. Reclaiming the land as cropland could occur within one to two years of soil restoration in some cases. Various sources [2,3], estimate reclamation to original productivities for prime cropland to take between 5 and 15 years.

Estimates for timing to restore rangeland to pre-mining productivities range from about one year in the Texas Coal Region [4] to between 5 and 15 years in the Northern Great Plains [3,5]. These are estimates, not precise forecasts, and only more research and experience will develop reliable information about restoration of long-term productivity in the grasslands and other semi-arid and arid areas of the West.

7.3.4 Wildlife

The potential for returning wildlife to reclaimed areas would be dependent upon the success of the vegetation reclamation efforts and reclaimed uses of the land.

Estimates of the wildlife population that the total areas reclaimed under the preferred alternative, mid-level coal production, could eventually support are given in Table 7-5. These estimates are based on regional carrying capacities developed for various wildlife populations as presented in Appendix Table D-1. The time to recover to stable wildlife populations is highly dependent upon individual species characteristics. The long-term reestablishment of wildlife populations must be considered in terms of the short-term site specific losses of both species numbers and habitat. This is directly related to the acreage commitments during the average 30-year life of a given mining site. As specific mining tracts are not identifiable in this statement, it is not possible to specifically identify habitat which would be disrupted. Nevertheless, any surface mining operation would result in a temporary loss of habitat for certain species.

Wildlife reestablishment will closely follow the successional stages of vegetation. Areas successfully replanted

in seedlings, for example, would be expected to follow a typical pattern for both plant and animal species. Windblown seeds that become established along with planted seedlings would increase plant diversity and provide additional opportunities for wildlife feeding, cover, and reproduction. The first inhabitants of a reclaimed area would include soil organisms, insects, arthropods, and rodents, followed by small mammals, foxes, and ground nesting birds. Young stands of pine (5 to 15 years) would attract numerous birds and would provide habitat and cover for deer and additional wildlife.

As noted previously, revegetation of range has been cited as taking from 3 years in Texas to as long as 5 to 15 years in western regions [3,5]. Usefulness of range reclamation to wildlife will depend upon the eventual mix of plant species that first establish and the succession that follows. Replanting with vegetation of only one type, as under cultivation, could limit the benefits to wildlife. Control of undesirable plant species and protection of newly established vegetation from grazing animal species may also be required for several years before reclaimed areas can be deemed successful in terms of maximum wildlife benefits.

7.3.5 Value of Crops Lost Due to Mining

Estimates of the average value of agricultural output lost due to implementation of the alternatives are presented in Table 7-2. These estimates were generated through use of the agricultural opportunity cost methodology summarized in Section 5.2.4.3 and presented in detail in Appendix Table H-6. For each western coal region, the average per acre opportunity costs were applied to the estimates of cropland disturbed on a short-term basis.

7.4 REFERENCES

1. Curtis, W., 1978. Personal communication. Northeast Forest Experiment Station. Berea, Kentucky.
2. Zellmer, S.D., 1978. Personal communication. Agronomist, Argonne National Laboratory. Argonne, Illinois.
3. Ross, L., 1978. Personal communication. Iowa Department of Soil Conservation, Division of Mines and Minerals.
4. Payne, R., 1978. Personal communication. Railroad Commission of Texas, Surface Mining Department.
5. Packer, P.E., 1974. Rehabilitation Potentials and Limitations of Surface-Mined Land in the Northern Great Plains. U.S. Department of Agriculture, Forest Service. Ogden, Utah.

TABLE 7-3

POTENTIAL PRODUCTIVITY THAT WOULD BE RETURNED TO
RECLAIMED LAND BASED ON LAND USE ALLOCATIONS
(All units $\times 10^3$)

Region	Total Land (acres)	POTENTIAL PRODUCTIVITY							
		Forest (tons)	Range (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Hay (tons)	Oats (bu)
Northern Appalachian	251	1,273	-	3,040	670	-	424	61	97
Central Appalachian	153	819	-	1,200	536	-	77	46	-
Southern Appalachian	114	561	-	800	643	570	-	27	-
Eastern Interior	336	596	-	13,635	1,235	-	926	25	-
Western Interior	240	472	209	3,485	973	-	1,310	54	-
Texas	410	1,044	974	-	-	6,354	652	48	-
Powder River	104	48	616	-	-	-	105	3	22
Green River -Hams Fork	107	104	150	48	-	-	58	6	21
Fort Union	60	21	221	-	-	-	344	11	105
San Juan	43	160	70	-	-	-	18	2	-
Uinta-Southwestern Utah	35	83	40	-	-	-	12	1	-
Denver-Raton Mesa	41	72	175	101	-	-	117	9	-

TABLE 7-4

ESTIMATES OF THE NUMBER OF ACRES* THAT WOULD BE IN SOME STAGE OF
RECLAMATION BY 1990, AND AMOUNT ALLOCATED TO FOREST RANGE OR CROPLAND
(Acres x 10³)

Region	Total Land (acres)	Forest (acres)	Range (acres)	CROPLAND					
				Corn (acres)	Soybeans (acres)	Cotton (acres)	Wheat (acres)	Hay (acres)	Oats (acres)
Northern Appalachian	251	143 (57%)	-	38 (15%)	25 (10%)	-	11 (14%)	32 (13%)	2 (1%)
Central Appalachian	153	92 (60%)	-	15 (10%)	20 (13%)	-	2 (1%)	24 (16%)	-
Southern Appalachian	114	63 (55%)	-	10 (9%)	24 (21%)	3 (3%)	-	14 (12%)	-
Eastern Interior	336	67 (20%)	-	135 (40%)	97 (29%)	-	24 (7%)	13 (4%)	-
Western Interior	240	53 (22%)	36 (15%)	41 (16%)	38 (16%)	-	45 (19%)	27 (11%)	-
Texas	410	147 (36%)	168 (68%)	-	38 (9%)	36 (9%)	28 (7%)	21 (5%)	-
Powder River	104	6 (6%)	92 (88%)	-	-	-	4 (4%)	1.5 (1%)	0.5 (1%)
Green River - Hams Fork	107	26 (25%)	75 (70%)	0.5 (1%)	-	-	2.5 (2%)	2.5 (2%)	0.5 (1%)
Fort Union	60	3 (7%)	33 (54%)	-	-	-	14 (23%)	7.5 (12%)	2.5 (4%)
San Juan	43	20 (46%)	22 (50%)	-	-	-	0.5 (1%)	0.5 (1%)	-
Uinta - Southwestern Utah	35	12 (34%)	22 (62%)	-	-	-	0.5 (1%)	0.5 (1%)	-
Denver-Raton Mesa	41	9 (21%)	23 (56%)	1 (2%)	-	-	5 (12%)	3 (7%)	-

*Estimated total acreage that would potentially be reclaimable under no new leasing mid-level production. Derived from Tables 5-7 and 5-8 (Land Disturbance).

TABLE 7-5

ESTIMATED NUMBERS OF WILDLIFE THAT COULD BE
SUPPORTED BY SUCCESSFULLY RECLAIMED LAND

Region	Total Land Reclaimed (acres) (x 103)	POTENTIAL WILDLIFE						Predators	Animal Units (x 103)
		Game Mammals (x 103)	Game Birds (x 103)	Small Mammals (x 103)	Birds (x 103)	Amphibians/ Reptiles (x 103)			
Northern Appalachian	251	18	63	2,510	879	628	502	115	
Central Appalachian	153	11	38	1,530	535	383	306	70	
Southern Appalachian	114	8	29	1,140	399	285	228	52	
Eastern Interior	336	10	31	3,360	1,176	840	672	198	
Western Interior	240	7	48	2,400	840	600	480	92	
Texas	410	24	82	4,100	1,435	1,435	820	62	
Powder River	104	8	3	936	104	260	208	7	
Green River - Hams Fork	107	8	17	5,885	268	482	214	12	
Fort Union	60	0.5	8	540	60	150	120	8	
San Juan	43	0.1	9	215	108	112	129	4	
Uinta -Southwestern Utah	35	0.3	7	175	88	91	70	4	
Denver-Raton Mesa	41	0.4	8	369	103	107	82	3	

CHAPTER 8

CONSULTATION AND COORDINATION

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CHAPTER 8

CONSULTATION AND COORDINATION

On July 25, 1977, a Department of the Interior news release informed the public that the Department would prepare an environmental impact statement before adopting new coal management policies and procedures to carry out President Carter's directive to manage Federal coal lands in an environmentally sound manner. Subsequently, on September 27, 1977, the Federal District Court for the District of Columbia ordered the preparation of a draft supplemental environmental impact statement pursuant to the *NRDC vs. Hughes* decision. Since these events, numerous consultations and extensive coordination have taken place during the development of the Federal coal management program. This chapter indicates the procedures followed.

8.1 PROGRAM DEVELOPMENT COORDINATION

The ground work for program development was conducted by field and Washington personnel. Task groups composed of departmental employees of various agencies were formed in February 1978. The main responsibility of the task groups was to identify issues and options which required a Departmental decision in order to develop a Federal coal management program. The primary issues and options were identified by May 1978. At that time, the task groups submitted issue papers to the Office of Coal Management, Bureau of Land Management, in Washington. Also occurring during this time period was the field testing of draft criteria for designating lands unsuitable for surface coal mining.

The issue papers were circulated to various departmental organizations during June 1978. The papers were reviewed for accuracy by the Bureau of Land Management prior to submittal to the Department's Office of Coal Leasing, Planning and Coordination. That office prepared issue/option papers to assist the Secretary in expressing preferences for use in the development of the preferred coal management program analyzed in this statement. The Secretary indicated his preference on June 30, 1978. Subsequent issue/option papers were prepared and employed in decisions reached by the Under Secretary on July 28, September 15, October 3, and November 2, 1978. Program development was coordinated with the Western States by the Denver based Assistant to the Director of the Office of Coal Leasing, Planning and Coordination.

In addition to the program development coordination described above, the Bureau of Land Management conducted interagency consultations concerning jurisdictional authorities and responsibilities. Major coordination activities have taken place between: (1) BLM and the Fish and Wildlife Service concerning wildlife management responsibilities, (2) BLM, Geological Survey, and the Office of Surface Mining Reclamation and Enforcement concerning coal mining

management responsibilities, and (3) between the Advisory Council on Historic Preservation, BLM, Geological Survey, and the Office of Surface Mining Reclamation and Enforcement concerning the protection of cultural resources on Federal lands. The Minerals and Geology Staff of the U.S. Forest Service provided assistance to the Department in the development of the issue papers. Memoranda of understanding have been prepared or are currently being completed to specify each agency's responsibility. During this entire process, BLM periodically conducted meetings to inform the western coal states of the status of the program's development. These meetings commenced in Denver on April 28, 1978, when the BLM State Directors and state government representatives advised on the issues and options being considered. Representatives of the western coal states were updated on the issues and options via a briefing held in Washington on May 23, 1978, and a followup meeting in Denver on June 8 and 9, 1978. Further meetings with BLM State Directors were held in Casper, Wyoming on September 12 and 14, 1978, to discuss the application of the proposed unsuitability criteria and the preliminary approach to possible mid-1980 leasing. The most recent series of meetings were held in Denver with the BLM State Directors on October 16 to 18, 1978, to refine programmatic details, discuss future programmatic planning efforts, and present the status of the BLM and the Fish and Wildlife Service memorandum of understanding concerning coal development-related wildlife management responsibilities (see Appendix B). In addition to the foregoing meetings, the Department's Office of Coal Leasing, Planning and Coordination and the Assistant Secretary, Land and Water Resources, held several briefing and information-gathering meetings in the West from January to July 1978 with representatives of the western states Governors' Offices and state resource agencies to obtain state and local government viewpoints on the program.

8.2 ENVIRONMENTAL IMPACT STATEMENT PREPARATION COORDINATION

This section specifies the environmental impact statement preparation consultations and coordination since the original Final Coal Leasing Programmatic Environmental Impact Statement was published on September 19, 1975 [1].

Consultation efforts for this document commenced with a departmental news release on November 17, 1977, which requested the public to comment on the 1975 final environmental impact statement. A total of 105 comments were received from various governmental, industrial, and private sources. Table 8-1 lists all commentators with an identification of significant categories of comments and indicates where in the text responsive relevant material can be

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
U.S. Army Corps of Engineers	Leasing policy comments. Department of Army permits may be required for production and transport of coal. Leasing program should avoid areas that are environmentally sensitive.	3.1; 3.3 Not Required. 5.2.3
U.S. Environmental Protection Agency Washington, D.C.	Use draft proposed CEQ regulations as a guide in preparing the new EIS. Adequate description of EMARS needed. MFP may not be adequate to fulfill congressional intent of "comprehensive land use." FEIS did not provide a sound basis on which to determine if renewed Federal coal leasing is needed. Table of Federal regulations affecting coal development. Detailed discussion of what the new EIS should include.	1.1; 1.1.2; 1.2.4 3.1.2.1; 3.1.3.1. 2.8; 2.9 1.3.1 Not Required.
Bureau of Reclamation DOI	Technical - are there ample reserves in existing bases to meet all the projected needs? - inadequately treated in EIS - additional specific comments. Program Policy - avoid encouragement of abandoning old sites before all coal is mined. Environment - concerned over water supply.	2.2 3.2.6 5.2.2.6
Bureau of Mines DOI	Reviewed, no comment.	No section.
Tennessee Valley Authority Knoxville, Tennessee	Conducted an economic study of the coal market which indicates low level of competition in the coal market may contribute to escalating prices. Leasing program should consider this by allowing entry of new companies into the market.	2.8.4
State of Alaska Clearinghouse	Alaska coal situation misrepresented. EIS now obsolete - old data, new legislation.	2.2 Not Required.
Arizona State Clearinghouse	Inadequate treatment of effects of surface mining on scientifically important fossils. Justification for extension of leasing is not provided. Little adverse environmental impact on Arizona is anticipated.	5.2.2.3 2.8; 2.9 5.2
State of Colorado Governor	Renewed Federal Leasing is needed. Urge timely resumption of leasing.	2.8; 2.9
State of Colorado Department of Natural Resources	List state objectives for coal development. Leasing of Federal coal is important but the rate of development and gravity of concomitant social impacts must be controlled. Encourage comprehensive land use planning. Leasing must be consistent with national energy needs. Need for further Federal leasing has not been clearly demonstrated. Discusses state participation. Detailed discussion of leasing policies.	3.1.3.5; 3.3.5 5.2.4 3.1.2.1; 3.1.3.1 3.1.2.2 2.8; 2.9 3.1.3.5; 3.3.5 3.1; 3.3
State of Colorado Geological Survey	Leasing policy discussed - Logical Mining Units State input Environmental, social impact mitigation Importance of Federal coal in Colorado.	2.8.2; 3.1.3.4 3.1.3.5; 3.3.5 5.2.3; 5.2.4; 6.1-6.3 2.2; 2.3; 2.4
State of Colorado Division of Planning	Need for further leasing, not clearly demonstrated: - Local involvement - State plans	2.8; 2.9 3.1.1; 3.1.3.5; 3.3.5

TABLE 8-1

COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
State of Colorado Department of Highways	Government should nominate acceptable leasing areas.	3.1.1
	Any EIS should include off-site and indirect considerations.	5.2
	State and local government involvement.	3.1.3.5; 3.3.5
State of Colorado Governor's Socioeconomic Impact Office	The need for renewed leasing has not been clearly demonstrated.	2.8; 2.9
	FEIS analysis of socioeconomic impacts is inadequate.	5.2.4
	EMARS should better consider socioeconomic impacts - suggestions made.	1.1; 1.1.2; 1.2.4
State of Colorado Executive Chambers	Socioeconomic impacts should be better considered in the leasing process - suggestions given.	5.2.4
State of Colorado Department of Health	Consider site-specific water quality impacts, leaching of radioactive or hazardous substances. Avoid wasting uranium in over-burden which could be economically recovered in 5-10 years.	5.2.2.6
State of Colorado Division of Mines	States should have more input. Royalties discussed. EIA should assess Forest Service manpower needed to implement reclamation.	3.1.3.5; 3.3.5
State of Colorado Board of Land Commissioners	State coal is affected by Federal leasing policy.	3.1.3.5; 3.3.5
State of Colorado Division of Wildlife	Distributions of Colorado wildlife species are available.	Not Required.
	Areas within the Known Coal Lease Areas have been ranked by importance to wildlife.	Not Required.
	Attachment of leasing policy suggestions.	Not Required.
State of Delaware Clearinghouse	No criticism.	No section.
Delaware River Basin Commission West Trenton, New Jersey	Increased coal mining in the east would be detrimental to stream biota because of acid runoff and increased sediment loads.	5.2.3
State of Idaho Clearinghouse	No comment by agencies performing review.	Not Required.
State of Iowa Clearinghouse	Is there a need for renewed Federal coal leasing? Yes.	2.8; 2.9
	If so, how should the program be defined? - program should include constraint on processing impacts.	3.1; 3.3
	If implemented, what would be the environmental impacts of various alternatives? Not qualified to comment.	5.2
State of Louisiana Department of Natural Resources	No coal leasing required in Gulf Coal Province which consists of primarily low BTU lignite.	2.2
	Program Policy - provide for physical access to leased land, provide for appropriate reclamation.	5.2.2.1
Lower Colorado River Authority Austin, Texas	Definite need for renewed Federal leasing. Program Policy - should satisfy local needs for local coal with minimal environmental impact.	2.8; 2.9 3.1
	Impacts of various leasing alternatives need to be further addressed. Sufficient regulation now exists for mining, burning, transport of coal and lignite.	3.1; 3.3

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
State of New Mexico Energy Resources Board	Much of New Mexico's coal is on Indian land. New Mexico wants to have input on deciding which Federal lands will be leased. Concern over environmental and social impacts of rapid development of coal resources. Need for renewed leasing has not been demonstrated. Alternative energy sources were not adequately discussed - especially solar, geothermal and effects of energy conservation.	2.7.2 3.1.3.5; 3.3.5 5.2.3; 5.2.4 2.8; 2.9 2.5
State of Mississippi Clearinghouse	No objections voiced.	Not Required.
State of Montana Office of the Governor	Criticisms of Draft EIS are still valid. Lists specific shortcomings of the EIS which must be considered. Is there a need for renewed Federal leasing? Cannot be determined at this time. Discussion of leasing program policy - and state involvement. Make suggestions on points to be addressed in new EIS.	Not Required. Not Required. 2.8; 2.9 3.1.3.5; 3.3.5
State of New Jersey Clearinghouse	No objections.	Not Required.
State of North Carolina Clearinghouse	No comment is necessary.	Not Required.
North Dakota State Intergovernmental Clearinghouse	Consider this EIS secondary to the more detailed seven county regional EIS.	1.1.4
North Dakota Game and Fish Department	Discussion of specific problems with the FEIS. Need for renewed Federal leasing has not been demonstrated. Program policy suggested involves Federal nomination of tracts for leasing.	Not Required. 2.8; 2.9 3.1
Public Service Commission State of North Dakota	No surface mining where reclamation cannot be effected. It is not in the public interest for oil companies to control coal resources.	3.1.1 Not Required.
Northern Tier Regional Planning & Development Commission Towanda, Pennsylvania	Reviewed, no comment offered.	Not Required.
State of Oregon Intergovernmental Relations Division	Referred to appropriate state agencies, no further comments received.	Not Required.
Powder River Basin Resource Council Sheridan, Wyoming	Coal development should have the overriding goal of avoiding environmental and social impacts. General goals presented for coal development. Environmental Statements discussed. Management Framework Plans inadequate.	5.2.3; 5.2.4 3.1 3.1.2.1; 3.1.3.1
Susquehanna River Basin Commission	Any comments submitted by Pennsylvania Department of Environmental Resources would reflect the stance of this commission.	Not Required.
State of Tennessee Clearinghouse	There are no Federal coal leasing areas in Tennessee.	Not Required.
State of Texas Department of Water Resources	Renewed leasing is required. Program policy - diligence, environmental regulation should be left to states.	2.8; 2.9 3.1.3.5; 3.3.5

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
State of Virginia	The following impacts that are treated by the FEIS in overview require more detailed treatment in regional EIA's:	5.2.2.7
	Demands on public utilities, air and noise pollution, destruction of endangered species, effects of caving from underground mining, long-term environmental effects.	5.2.3.3
	Too general in discussing effects of siltation on stream biota.	7.1 5.2.3
State of West Virginia Clearinghouse	Don't need further Federal leasing. - rely on Eastern Coal (Photos misrepresented coal industry in Appalachia - corrected in Final EIS).	2.8; 2.9
	Technical - estimation of coal reserve base only to 1000' rather than the conventional 3000' - underestimates Eastern Coal reserve base.	2.2
	Eastern "mine-mouth" plants are faced with geographic dilemma of high transportation costs - not true.	5.3
	Better to develop Eastern Coal than to lease Western Coal land. Eastern and Western Coal should be compared on BTU/SO ₂ /water basis in the EIS. Western low-sulfur Coal has less BTU content than Eastern. General bias toward development of Western Coal.	
Tri-County Planning Office Newcastle, Wyoming	No need for renewed leasing.	2.8; 2.9
	Program policy should have a national perspective for need for coal, and a local or regional perspective on availability, cost and impacts.	2.2-2.4; 2.6; 5.2
	Environmental impacts cannot be assessed without further specific information.	5.1; 5.2
Tri-County Regional Planning Office Harrisburg, PA	Reviewed, no comment offered.	Not Required.
State of Utah Office of the Governor	Renewed leasing is required.	2.8; 2.9
	Policy comments - reduce Federal control - let market determine mining needs.	3.3.4
	Lease applications should be processed by state BLM offices.	1.3
	Exchange of existing leases for leases on areas more suitable for development.	
State of Wyoming	Renewed leasing is needed.	2.8; 2.9
	Program Policy - control rate of leasing by federal administration stop speculation ensure environmental protection fair market competition.	1.3.1
State of Wyoming Game and Fish Department	Wildlife resource not adequately considered.	5.2.3
	Did not demonstrate need for renewed Federal coal leasing.	2.8; 2.9
	Alternatives to proposed action were not adequately treated.	3.3
	Discusses program policy.	
	Areas least affecting wildlife should be leased.	5.2.3
	Lists specific FEIS weakness.	Not Required.

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
American Mining Congress Washington, D.C.	Yes, additional leasing is needed. Program Policy - must consider environment, consumer cost and industry profit - present environmental regulations are sufficient - detailed suggestions on policy - warning against over control by government.	2.8; 2.9 5.2 1.3
Arch Mineral Corp. St. Louis, Missouri	Federal leasing is required to preserve Logical Mining Units. Program Policy - leases should be industry initiated under government regulation. Short term criteria at the Medicine Bow and Seminole II mines are important. Attachment: Congressional testimony, supplement to short term criteria.	2.8.2; 3.1.3.4 3.3.4 Not Required. Not Required.
Arizona Public Service Company Phoenix, Arizona	There is a need for renewed Federal leasing. Program should allow timely resumption of leasing, make coal available to all bidders, provide for diligent, rational coal development. Program modifications recommended and discussed. Environmental impact of leasing alternatives cannot be predicted with current data base.	2.8; 2.9 3.1; 3.3 Not Required. 5.2
Coastal States Energy Company Houston, Texas	Renewed Federal leasing is needed. Leasing policy must be flexible. Industry identified leasing tracts.	2.8; 2.9 3.1; 3.3 3.3.4
Central and Southwest Corporation	Renewed leasing is needed.	2.8; 2.9
Coal Fuels - WILDE Rollinsville, Colorado	Need more Federal leasing. Program Policy Comments - conserve Logical Mining Units. No danger of adverse environmental effects.	2.8; 2.9 2.8.2; 3.1.3.4 5.2
Leva, Hawes, Symington, Martin and Oppenheimer Washington, D.C. for Commonwealth, Edison Company Chicago, Illinois	Renewed leasing is necessary - provides extensive discussion of this point. Program Policy should - provide coal quickly in cases where it is needed, and - additional development should be considered on a case-by-case basis. Leasing must be resumed quickly and regulations kept minimal to avoid serious social and economic impacts.	2.8; 2.9 3.1; 3.3 3.1; 3.3
Energy Fuels Corporation Denver, Colorado	Additional leasing is needed - especially to preserve Logical Mining Units.	2.8; 2.9
Freeman United Coal Mining Company Mt. Vernon, Illinois	Is there a need for more coal leasing? Yes. "No action" alternative misrepresented. Program Policy - competitive leasing suggested Preferential Right Leasing. Doesn't feel that impact of different levels of leasing can be predicted with sufficient accuracy to limit leasing before the fact.	2.8; 2.9 3.1; 3.3 3.1; 3.3 5.2
Kaiser Engineers Oakland, California For Mono Power Company and Resources Company	There is a need for renewed leasing. Program Policy - outlines proposed leasing procedure. Environmental Impact of leasing alternatives are adequately controlled under existing regulations.	2.8; 2.9 3.1; 3.3 1.3.1
Kansas City Power and Light Kansas City, Missouri	Renewed leasing is required.	2.8; 2.9

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
WYMO, Inc. Casper, Wyoming	New leasing is required.	2.8; 2.9
Duncan, Brown, Weinburg and Palmer for Western Fuels Association, Inc.	Renewed leasing is required. Program Policy should: provide coal where it is needed, consider economic and environmental aspects. General support of EMARS.	2.8; 2.9 5.1; 5.2 Appendix H Chapter 3
Western Energy Company Butte, Montana	Yes - additional Federal Leasing Programs are needed - evaluate on a site - specific basis. Policy - must preserve Logical Mining Units - for mining and reclamation purpose. EMARS needs revision - too time consuming. Industry should initiate leasing process. Environmental considerations are adequately addressed.	5.2 2.8.2; 3.1.3.4 1.1; 1.1.2; 1.2.4 5.2
WESCAR, Incorporated Lakewood, Colorado	There is a need for renewed Federal Coal Leasing. Program Policy should consider leasing to large and small operators. Environmental Impacts of various leasing policies cannot be predicted at this time.	2.8; 2.9 2.8.4 5.2
Utah International, Inc. San Francisco, Calif.	Renewed leasing is required because supplies are inadequate and Logical Mining Units should be preserved. Program Policy recommendations made minimal Federal control. Environmental Impacts are not a major concern as they are adequately addressed in existing regulatory measures.	2.8.2; 3.1.3.4 3.1; 3.3 5.2
SUNOCO Energy Development Co. Dallas, Texas	There is a need for renewed Federal leasing. Program Policy - leasing process initiated by industry, government EIS prepared, industry bids, diligent development proceeds under government permits. All potential environmental impacts are already controlled sufficiently.	2.8; 2.9 1.3; 3.1; 3.3
Southern California Edison Company Rosemead, California	Preserve Logical Mining Units. Renewed leasing is required. Discusses some aspects of leasing policy.	2.8.2; 3.1.3.4 2.8; 2.9
Santa Fe Industries, Incorporated	Renewed Federal leasing is needed. EMARS is adequate. What are impacts of proposed leasing alternatives? Cannot be assessed without further information.	2.8; 2.9 1.1.2; 1.2.4 5.2
Salt River Project Phoenix, Arizona	Renewed Federal leasing is needed. Program Policy - EMARS is inadequate. Impact of various alternatives discussed. "No action alternative" - make low sulfur coal less available and more costly and break up Logical Mining Units.	2.8; 2.9 1.1.2; 1.2.4 5.2
Rocky Mountain Energy Co. Denver, Colorado	Additional leasing is needed, especially to preserve Logical Mining Units.	2.8; 2.9
Peabody Coal Company St. Louis, Missouri	EIS Weaknesses - inadequate description of proposed program; too long; no effective summary - conclusion; misleading - text and photos. There is a need for renewed leasing. Existing regulations are sufficient to protect the environment.	3.1; 3.3 6.1; 6.2; 6.3 2.8; 2.9 1.3

TABLE 8-1
COMMENTS ON 1976 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
Natural Gas Pipeline Company of America Chicago, Illinois	There is a need for renewed leasing. Program - leases for projects (1) in the national interest, (2) are economically fair. Environmental Aspects - gasification best.	2.8; 2.9 Appendix H
National Coal Association	There is a need for renewed leasing. Presents questions that must be addressed in EIS: not enough coal available, must preserve Logical Mining Units, minimal governmental control, flexibility (consider cost, environment, profit), predictable, consistent and simple program. Environment Impacts of Leasing Alternatives - not of concern under existing regulatory measures - all alternatives identical.	2.8; 2.9 3.1 5.2
Aiken Audobon Society Colorado Springs, CO	Is there a need for more coal mine leases? - No. Current Management Framework Planning System is inadequate.	2.8; 2.9 3.1.2.1; 3.1.3.1
Lucille Bawbridge Cortez, Colorado	Renewed leasing is not required.	2.8; 2.9
Capital Legal Foundation Washington, D.C.	A legally adequate EIS, when prepared, will be challenged in court. This will result in wasted time which is not in the public interest.	Not Required.
Citizen's Coal Project Environmental Policy Institute Denver, Colorado	Renewed Federal leasing - must be re-analyzed and outline of points that should be considered. Leasing Program Policy - Coal lands, land use priorities, existing leases should be considered. Environmental Impacts cannot be determined without additional specific information and analyses.	3.1; 3.3 2.2; 3.1; 3.3 5.2
Citizens for a Better Environment San Francisco, Calif.	EIS: does not demonstrate need for additional coal leasing; proposed a leasing policy that will allow gross mismanagement of public resources; does not adequately discuss alternative leasing program; provides detailed discussion of each of these points - a letter must be considered in writing the new EIS.	2.8; 2.9; 3.3
Paul Clar Denver, Colorado	Don't need further leasing. Concerned over environmental impact.	2.8; 2.9 5.2
John Cochran Hualepia Mountains	All Federal control on mining should be removed - all government land should become privately owned. All EIS's are worthless, EPA should be abolished.	Chapter 2 Not Required.
Colorado Open Space Council Denver, Colorado	EIS has not demonstrated a clear need for renewed Federal leasing. Program must include implementation of environmental protection measures as provided by legislation. New land use planning system must be devised - Management Framework Plan is not adequate.	2.8; 2.9 1.3.1; 6.1-6.3 3.1.2.1; 3.1.3.1
David Ellis Jackson, Wyoming	Renewed leasing is required.	2.8; 2.9
Environmental Defense Fund Denver, Colorado	Comments submitted on DEIS are still valid. No renewed Federal leasing is currently required.	2.8; 2.9
Dwight Filley Denver, Colorado	We don't need more Federal leasing for coal.	2.8; 2.9

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
Friends of the Earth San Francisco, Calif.	Renewed leasing is not necessary. Comprehensive land use planning system needed.	2.8; 2.9 3.1.2.1; 3.1.3.1
The Human Side of Coal Energy Development	FEIS is inadequate in describing social impacts. Rapid development of coal resources would have serious social impacts.	5.2.4 5.2.4
Page T. Jenkins - Geologist Denver, Colorado	Technical - must consider role of new coal energy technologies (gasification, liquifaction) when projecting future coal needs.	Appendix H
William A. Kint Boulder, Colorado	No further leasing required. Program Policy - government should select sites; environmental regulation is very important; implement comprehensive land use plan.	2.8; 2.9 1.3 3.1.2.1; 3.1.3.1
Karen Kleehammer Denver, Colorado	Don't need more leasing now. Concerned over environmental impacts of coal development.	2.8; 2.9 5.2
Patty Kluver Forsyth, Montana	Inadequate treatment of alternative energy sources: especially wind, geothermal.	2.5
Susan Light Denver, Colorado	Is there a need for renewed leasing? - No. Feds should develop solar energy alternative. Concerned over environmental impact. Management Framework Planning system is inadequate.	2.8; 2.9 2.5.5.6 5.2 3.1.2.1; 3.1.3.1
McCane Agricultural Protection Organization Circle, Montana	Suggest more effective public involvement. Management Framework Plans inadequate. No leasing should occur if the land surface is privately owned. Need for renewed leasing has not been demonstrated.	3.1.1 3.1.2.1; 3.1.3.1 3.1.3; 3.2.4 2.8; 2.9
Law Office of Bruce J. Terres For Natural Resources Defense Council	EIS should concentrate more on analysis of alternatives rather than serving a primarily descriptive function. Should analyze "no action" alternative which, if rejected, would justify a renewal of Federal leasing - provides good discussion of "no action" considerations. Lists several analyses which should be addressed in the EIS. Program Policy - discussion of EMARS not adequate; provides suggestions on leasing policy; mitigation section inadequate - should provide mechanisms. Provides overall discussion of what the EIS should include.	5.2 5.2 1.1.2; 1.2.4 3.1; 3.3 6.1; 6.2; 6.3
Northern Plains Resource Council	Determination of leasing program needs more public involvement.	3.1.1
Jay Owen Ashland, Montana	Renewed Federal coal leasing is needed.	2.8; 2.9
William Palmer Cedaredge, Colorado	No renewal of leasing is needed. Formulate comprehensive land use plan. Lease tracts initially identified by government.	2.8; 2.9 3.1.2.1; 3.1.3.1 1.3.2
Henry F. Pohlman Farmington, New Mexico	Renewed leasing program is needed. Program Policy discussion. See little relationship between leasing method and environmental impact.	2.8; 2.9 3.1; 3.3 5.2

TABLE 8-1
COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONTINUED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
Melinda Reed Wheat Ridge, Colorado	No need for further leasing. Comprehensive land use plan needed if leasing is to be continued.	2.8; 2.9 3.1.2.1; 3.1.3.1
K. Bruce Robinson Morrison, Colorado	Program - comprehensive land use plan needed - Not reaction to industry proposals. Strict criteria needed for environmental regulation.	3.1.2.1; 3.1.3.1 1.3
Rosebud Protection Association Forsyth, Montana	No leasing should occur in situations where surface land is privately owned. Suggests studies of reclamation efficiency, effectiveness. Suggest more effective public involvement. Leasing tracts should be identified by the D.O.I., not the coal industry.	3.1.3; 3.2.4 5.2.2.1 3.1.1 1.3.2
Sierra Club North Dakota Group	FEIS inadequately addressed: acid rainfall; air quality; groundwater pollution/displacement; reclamation problems in special habitats; wildlife destruction. Coal development is a threat to agricultural production and society. Is lignite "low sulfur" in terms of sulfur produced per BTU? No leasing if surface owner objects. Need for coal leasing not clearly demonstrated.	5.2.2.7 5.2.2.6 5.2.2.1 5.2.3 5.2.3.1; 5.2.4.3 3.1.3; 3.2.4 2.8; 2.9
Society of Vertebrate Paleontology Boulder, Colorado	Mitigation procedures (pp. 4-21) should include mandatory surveys for paleontological materials.	5.2.2.3
Dean B. Suagee Washington, D.C.	FEIS does not demonstrate a need for renewed Federal leasing, discussions of energy alterna- tives are inadequate, especially for wind, and solar. Includes detailed discussion of wind energy.	2.5; 2.8; 2.9 Not Required.
Surface Mining Research Library Charleston, West Va.	Discussion of leasing alternatives. Photos are of outmoded (strip mining techniques) and are misleading - Appalachian low sulfur coal is present and available. Eastern Coal reserves artificially limited to 1000' depth - can't justify this. Several technical points are presented that should be considered in the new EIS. Consider further development of Eastern Coal - lease Western Coal only when it will be used west of the Mississippi. Supports preservation of Logical Mining Units through Federal leasing.	3.3 2.2 2.8.2; 3.1.3.4
Roland C. Townsend - Consulting Geologist Green Valley, Arizona	"No action" alternative not considered ade- quately. Is there a need for renewed Federal Coal Leasing? - Yes - technical justification presented. Discussion of Program Policy - general favor- able - must be flexible, responsive. Projections of environmental effects is not really possible at this time - inadequate data.	2.8; 2.9; 5.2 3.1; 3.3 5.2
Tri-County Ranchers Association	Consider Gold/Jobs Study in Montana - local opinion 83% against mining. Discusses problems with Management Framework Plan. BLM does not control surface of many coal reserves. Suggests changes in land use planning.	3.1.2.1; 3.1.3.1 3.1.2.1; 3.1.3.1

TABLE 8-1

COMMENTS ON 1975 FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED FEDERAL COAL MANAGEMENT PROGRAM
(CONCLUDED)

COMMENTOR	SUMMARY OF COMMENT	SECTION WHERE COMMENT ADDRESSED
Wibaux Area Council	Suggest more public involvement.	3.1.1
Chuck Worley Cedaredge, Colorado	Further leasing is not required at this time. Program Policy. Speculative leasing is to be avoided. Repossess leased coal land not being used for mining. Encourage orderly development of coal resources determined by BLM, not industry. Do not lease any areas where mining would be environmentally unacceptable.	2.8; 2.9 3.1; 3.3 1.3.1 3.1; 3.3 5.2

LONG TERM ENVIRONMENTAL CONSEQUENCES

found. These comments were considered prior to the preparation of this document.

Thereafter, BLM negotiated a contract with The MITRE Corporation to assist in the preparation of this statement. This contractual assistance commenced on April 14, 1978. Subsequently, the contractor and the Department of the Interior consulted with the organizations listed on Table 8-2 to obtain advice and information for the preparation of this statement.

Three types of consultation occurred during preparation of this statement. Specifically, these were the circulation of the draft environmental statement outline, coordination with the Department of Energy to determine coal production level scenarios, and the circulation of copies of the preliminary draft environmental statement. *The Format Outline for Coal Programmatic DES* was made available to the general public upon request via a *Federal Register* notice on July 31, 1978 [2]. The alternative coal production levels which serve as the basis for impact analysis in Chapter 5 were derived from production projections provided by the Department of Energy. Lastly, the preliminary draft environmental statement, which represented a "first cut" effort of the draft environmental statement, was distributed to selected agencies for comment. In addition to the Departmental agencies, the Department of Energy, U.S. Forest Service, U.S. Environmental Protection Agency and western state Governors' Offices received preliminary draft environmental statement copies with a request for comments.

Representatives of western state Governors' Offices participated jointly with departmental representatives in the review of the preliminary draft statement. The assistance of these representatives was of substantial value in the assessment and analysis of key program issues, policy implications and effects on state and local government policies, plans and programs. All preliminary draft environmental statement comments which were submitted in a timely manner were considered prior to the printing of this draft statement. Where appropriate, the statement reflects these comments.

This draft environmental statement is being distributed to a wide range of individuals and organizations. The distribution list is too lengthy to include in this statement because it involves over 1,000 names. It does, however, include those parties listed in Table 8-1, all fifty state clearinghouses, and the Federal agencies listed in Table 8-3.

To provide an additional opportunity for comment and to submit information on this draft environmental impact

statement, a series of public meetings will be held in key coal field communities and regional centers throughout the Western United States. These meetings will be conducted during January and February, 1979, in Billings, Montana; Casper, Wyoming; Sheridan, Wyoming; Rock Springs, Wyoming; Bismarck, North Dakota; Dickinson, North Dakota; Salt Lake City, Utah; Price, Utah; Denver, Colorado; Grand Junction, Colorado; Albuquerque, New Mexico; and Farmington, New Mexico. The purpose of these meetings will be to present the information contained in this statement and to provide an opportunity for the general public and interest groups to discuss the statement and its content with departmental officials on an open-forum basis. Maximum participation by the public at these meetings will be solicited.

In addition to the public meetings, formal hearings on this draft environmental impact statement will be held during the 60-day review period following the release of this statement. The hearings which are scheduled to be held during late January and early February, 1979, will be conducted in Washington, D.C.; Denver, Colorado; Craig, Colorado; Salt Lake City, Utah; Billings, Montana; Albuquerque, New Mexico; Casper, Wyoming; Lexington, Kentucky; Chicago, Illinois; and Bismarck, North Dakota. Because of the nationwide scope of this statement, locations were chosen throughout the United States to enable all interested parties to participate fully in the hearings process.

Time, dates, and location for the meetings and for the hearings will be announced in the national and regional news media. Additionally, all Bureau of Land Management offices will have information available on the meetings and hearings.

All substantive comments received on this draft environmental impact statement will be analyzed to determine whether revisions or modifications should be made in the statement. The final version of this statement will reflect the consideration given to the comments.

8.3 REFERENCES

1. U.S. Department of the Interior, 1975. Final Environmental Impact Statement proposed Federal Coal Leasing program. Bureau of Land Management, Washington, D.C.
2. U.S. Department of The Interior, 1978. The Format Outline for Coal programmatic DES. *Federal Register* 43 (FR) 147:33348-33349.

TABLE 8-2 CONTINUED

TABLE 8-2

ORGANIZATIONS CONSULTED DURING PREPARATION OF THIS STATEMENT

FEDERAL GOVERNMENT AGENCIES

Advisory Council on Historic Preservation
Office of the General Counsel
Department of Agriculture
Division of Forestry, Forest Sciences Laboratory,
Logan, Utah
Economic Research Service
Forest Service
Land Inventory and Monitoring Division
Livestock and Range Research Station, Miles City,
Montana
Northeast Forest Experiment Station, Berea, Kentucky
Department of Commerce
Bureau of the Census, Population Division
Bureau of Economic Analysis
Economic Development Administration
Department of Energy
Argonne National Laboratory, Land Reclamation Office
Division of Coal
Division of Petroleum and Natural Gas
Division of Non-Ferrous Metals
Federal Energy Regulatory Commission
Leasing Policy Development Office
U.S. Department of Health, Education, and Welfare
Health Resources Administration
National Institute of Occupational Safety and Health
Department of the Interior
Bureau of Land Management, Office of Coal Management
Heritage Conservation and Recreation Service, National
Register Office; National Landmarks Group;
Interagency Archaeological Services
Geological Survey
Office of Surface Mining
Bureau of Mines
Department of Justice
Law Enforcement Assistance Administration
Department of Labor
Bureau of Labor Statistics, Wholesale Price Index
Division
Mine Safety and Health Administration
Department of Transportation
Federal Railroad Administration

TABLE 8-2 CONTINUED

Environmental Protection Agency
Municipal Operations Branch
Region IX
Interstate Commerce Commission
Water Resources Council

STATE AND LOCAL GOVERNMENTS

Alabama Division of State Parks
Alabama Forestry Commission
Arizona State Parks
Arkansas Department of Parks and Tourism
California Air Resources Council
Colorado Air Pollution Control Board
Colorado Department of Natural Resources
Division of Mine Land Reclamation
Division of Parks and Outdoor Recreation
Georgia Department of Natural Resources
Parks and Historical Sites Division
Idaho Department of Parks and Recreation
Illinois Department of Conservation
Illinois Department of Mines and Minerals
Land Reclamation Division
Indiana Department of Natural Resources
Division of State Parks
Iowa Department of Soil Conservation
Division of Mines and Minerals
Iowa State Conservation Commission
Iowa State University
Kansas Forestry, Fish and Game Commission
Kansas State Park and Resources Authority
Kentucky Air Pollution Control Board
Kentucky Division of Parks
Louisiana Department of Wildlife and Fisheries
Louisiana State Park and Recreation Commission
Missouri Department of Conservation
Forestry Division
Missouri Department of Natural Resources
Division of Parks and Recreation
Land Reclamation Program
Montana Department of Fish and Game
Recreation and Parks Division
Montana Department of State Lands
Reclamation Division

TABLE 8-2 CONTINUED

Nebraska Game and Parks Commission
New Mexico Bureau of Mines and Mineral Resources
New Mexico State Park and Recreation Commission
North Dakota Park Service
North Dakota Public Service Commission
Ohio Department of Parks and Recreation
 Division of Natural Resources
Oklahoma Department of Mines
Oklahoma Department of Wildlife Conservation
Oklahoma Division of State Parks
Pennsylvania Department of Environmental Resources
 Bureau of State Parks
South Dakota Department of Game, Fish and Parks
 Division of Parks and Recreation
State Council of Governments
Tennessee Department of Conservation
 Division of State Parks
Texas Forest Service
Texas Parks and Wildlife Department
 Parks Division
Texas Railroad Commission
 Surface Mining Department
Utah Department of Natural Sources
 Oil, Gas, and Mining Division
 Division of Parks and Recreation
 Division of Wildlife Resources
Utah State Forester Office
Virginia Department of Conservation and Economic Development
 Division of Parks
West Virginia Department of Natural Resources
 Division of Parks and Recreation
West Virginia University
 School of Forestry
Western Interstate Energy Board
Wyoming Department of Environmental Quality
 Land Quality Division
Wyoming Department of Revenue and Taxation
 Wyoming Game and Fish Department
 Wyoming Recreation Commission

INDUSTRY

American Mining Congress
Bituminous Coal Operators' Association
Burlington Northern Railroad
Chicago and North Western Transportation Company
Kemmerer Coal Company

TABLE 8-2 CONCLUDED

National Coal Association
Utah Power and Light Company

PRIVATE INDIVIDUALS AND ORGANIZATIONS

Geraghty and Miller, Incorporated
Hunter, Tom
Jansen, Dr. Ivan J.
Los Alamos Scientific Laboratory
National Geographic Society
Schiff, Dr. Daniel
Society of American Foresters

TABLE 8-3

FEDERAL AGENCIES REQUESTED TO COMMENT ON THE
DRAFT ENVIRONMENTAL STATEMENT

Advisory Council on Historic Preservation
Appalachian Regional Commission
Council on Environmental Quality
Department of Agriculture
 Soil Conservation Service
 Forest Service
Department of Commerce
Department of Defense
 Army Corps of Engineers
Department of Energy
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
 Bureau of Mines
 Bureau of Indian Affairs
 Bureau of Reclamation
 Fish and Wildlife Service
 Geological Survey
 Heritage Conservation and Recreation Service
 National Park Service
 Office of Surface Mining
Department of Labor
 Mining Safety and Health Administration
 Occupational Safety and Health Administration
Department of State
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National Aeronautics and Space Administration
National Science Foundation
Nuclear Regulatory Commission

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APPENDIX A

EXAMPLE REGULATIONS

APPENDIX A

EXPLANATION OF "EXAMPLE REGULATIONS"

The following example regulations are intended to indicate the form and content of regulations the Department might propose if the Secretary were to select the preferred program described in Chapter 3. These example regulations provide additional opportunity to obtain a sound understanding of how the Department would manage Federal coal resources under the preferred program. Their only purpose is to ensure a complete understanding of the preferred program and how it could be implemented. They reflect all of the considerations described in Chapter 3 and certain additional changes from the former coal program regulations that would be required to bring them into balance with the preferred program or for more efficient administration. The Department would locate all Federal coal resource regulations in Title 43 of the *Code of Federal Regulations* within one Group, §3400.

The example regulations were drafted under procedures similar to those that would be used to prepare proposed regulations, with review by all key agencies. The example regulations are also indicative of the extent and depth of coverage of any Federal coal management program regulations which the Department would adopt. Additional and detailed working procedures of a coal management program would be defined through agency field office guidelines, instruction memoranda and manuals.

As these example regulations are only intended to aid reviewers to better understand the preferred program and are not intended to serve as proposed rulemaking, reviewers of this document should address comments primarily to the text of this environmental impact statement and to the program structure and to the example regulations only as time permits or as appropriate.

While reviewing these example regulations, the reader should keep in mind that the responsibility for promulgating regulations on diligent development and alternative bidding systems was transferred to the Department of Energy under its

organization act (42 U.S.C. 7101 et seq). The Department of Energy is expected to publish proposed rules prior to the Secretary's decision on a new coal leasing system. The Department of Energy regulations will be incorporated in the final coal program when they became final.

The Department of Interior will, simultaneous with the issuance of this draft environmental impact statement, be giving notice in the *Federal Register* of intent to propose rules together with a full description of the regulation development process. During March 1979, the Department will publish the proposed rulemaking. Comments on program elements described in this statement will be considered in the drafting of this proposed rulemaking. By scheduling the proposed rulemaking to fall between the publication of the draft and final environmental impact statements, the Department is seeking to provide the public with sufficient time to comment on the proposed rules without the burden of simultaneously addressing the varied issues discussed in the environmental impact statement. Inclusion of example regulations and the detailed program description in this statement offers interested citizens an extra period of time to become thoroughly familiar with the preferred program and to develop their views of it prior to being requested to make specific comments on the proposed regulations. If the Secretary decides to adopt a new coal management program in June 1979, the final regulations will be prepared and published within two months following the date of his decision. The preparation period following the Secretary's decision will be as short as possible but of sufficient length to provide the Department with the time necessary both to ensure that the final regulations fully and accurately reflect the Secretary's decision and to take into consideration the general comments received during the environmental impact statement process and the specific comments submitted on the proposed regulations.

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AUTHORITY: 30 U.S.C. 181 et seq.; 30 U.S.C. 351-359; 30 U.S.C. 521-531; 30 U.S.C. 1201 et seq.; 42 U.S.C. 7101 et seq.; and 43 U.S.C. 1701 et seq.

§ 3400.0-3 Authority.

These regulations are issued under the authority of:

- (a) The Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181 et seq.).
- (b) The Mineral Leasing Act for Acquired Lands of August 7, 1947, as amended (30 U.S.C. 351-359).
- (c) Federal Land Policy and Management Act of 1976, October 21, 1976 (43 U.S.C. 1701 et seq.).
- (d) Surface Mining Control and Reclamation Act of 1977, August 3, 1977 (30 U.S.C. 1201 et seq.).
- (e) Multiple Mineral Development Act of
- (f) Department of Energy Organization Act of August 4, 1977 (42 Stat. 7101 et seq.). August 13, 1954 (30 U.S.C. 521-531).

§ 3400.0-4 Responsibilities

- (a) The Bureau of Land Management has the responsibility on public lands to:
 - (1) exercise the authority of the Secretary to determine the acceptability of lands for mineral leasing and development;
 - (2) issue mineral leases and serve as the Office of Record for the Federal mineral leasing programs;
 - (3) ensure that fair market value is received for Federal coal before issuing a lease;
 - (4) issue and administer all use authorizations for facilities related to mineral development outside the immediate area of mining operations;
 - (5) determine, in consultation with the Office of Surface Mining Reclamation and Enforcement, the appropriate post-mining land use of surface mined lands;
 - (6) include terms in each mineral lease to protect nonmineral resources and to ensure reclamation of mined lands to the applicable standards;
 - (7) initiate action to cancel leases for noncompliance with lease terms;
 - (8) consult with other surface management agencies and private owners, when they are involved in or affected by coal management actions that are the primary responsibility of the Bureau of Land Management; and
 - (9) administer exploration licenses.
- (b) The Geological Survey has the responsibility to:
 - (1) exercise the authority of the Secretary with respect to production and resource recovery in the area of operations;
 - (2) make geologic, engineering, coal resource economic values and maximum economic recovery determinations for the Department of Interior's mineral leasing program;

(3) review and concur with mining and exploration plans and amendments to establish production and resource recovery requirements;

(4) exercise the authority of the Secretary with respect to coal exploration on Federal lands; and

(5) serve as the Secretary's representative in dealing with operators on the matters listed in this subsection.

(c) The Office of Surface Mining Reclamation and Enforcement has the responsibility to:

(1) approve mining and reclamation permit applications;

(2) ensure that mining operations are consistent with environmental criteria and reclamation plans;

(3) monitor reclamation operations for compliance with plans;

(4) act as the Secretary's representative in dealing with operators during mining operations to ensure compliance with the environmental and reclamation requirements of the Surface Mining Control and Reclamation Act of 1977; and

(5) ensure that the rights of holders of noncoal Federal leases and permits are protected in the permit approval process.

(d) The Fish and Wildlife Service has the responsibility to:

(1) exercise the authority of the Secretary to protect and conserve endangered and threatened species, migratory birds, eagles, other fish and wildlife, and review water development projects;

(2) recommend lands unsuitable for leasing due to fish and wildlife and related ecological values;

(3) recommend tract ranking factors, weights, and values for fish and wildlife;

(4) recommend lease stipulations for fish and wildlife;

(5) review and recommend post-mining land uses of surface mined lands; and

(6) review exploration, mining, and reclamation plans.

§ 3400.0-5 Definitions.

As used in this part;

(a) "Alluvial valley floors" means unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities. This definition does not encompass upland areas generally covered by a thin veneer of alluvial deposits composed chiefly of debris from sheet erosion; deposits laid down by unconcentrated runoff or slope wash, including talus; other mass movement accumulations; and windblown deposits.

(b) "Authorized officer" means any employee of the Bureau of Land Management delegated the authority to perform the duty described in the section in which the term is used.

(c) "Bonus" means that value in excess of the rentals and royalties that accrues to the government because of coal resource ownership.

(d) "Certificate of bidding rights" means a right to apply the fair market value of a relinquished Federal coal lease or right to a preference right lease as a credit against the bonus bid on a competitive coal lease acquired at any subsequent Federal coal lease sale.

(e) "Coal deposits" means all federally-owned coal deposits subject to disposal under applicable law, except those held in trust for Indians.

(f) "Coal reserve" means coal quantities economically feasible to extract.

(g) "Coal resource economic value (CREV)" means the value of the coal resource in its best operational and market application, which, after allowances for surface costs will be the value of the recommended minimum bonus bid and royalty.

(h) "Commercial quantities" as used in paragraph (k) means: (1) for any coal lease issued after Aug 4, 1976, commercial quantities means one percent of the LMU reserves per year.

EXAMPLE REGULATIONS

(2) for any coal lease issued after Aug 4, 1976, commercial quantities means one-fortieth of the LMU reserves per year.

(i) "Continued operation" means the production of coal equal to one percent of the Logical Mining Unit (LMU) reserves for each of the first two years following the achievement of diligent development, and thereafter an average amount of one percent of the LMU reserves associated with the lease. The annual average amount shall be computed on a three year basis, and the three-year period for which the average shall be computed shall consist of the year in question and the two preceding years.

(j) "Contiguous" means having at lease one point in common, including cornering tracts.

(k) "Diligent development" means (1) for any Federal coal lease issued after August 4, 1976, the timely preparation for and initiation of coal production from the LMU of which the lease is a part so that coal is actually produced in commercial quantities by the end of the tenth year from the effective date of the lease.

(2) For any coal lease issued before August 4, 1976, the timely preparation for and initiation of coal production from the LMU so that coal is actually produced in commercial quantities before June 1, 1986, except that the period of time during which production of coal in commercial quantities must be achieved may be extended as provided in 43 CFR 3475.4.

(l) "Existing Mining Operation" means that area of private, State, or Federal leased or licensed lands (within a logical mining unit) containing surface or underground excavation or support facilities that (1) contribute directly to coal mining, preparation and handling; (2) produce coal as a commercial venture, which is defined as a venture having a historic production record or having existing contractual production commitments or both; and (3) contain coal reserves intended for extraction in the course of the mining operation.

(m) "Exploration" means drilling, excavating, and geological, geophysical or geochemical surveying operations designed to obtain detailed data on the physical and chemical characteristics of coal deposits and their environment including the strata above and below the deposit, the hydrologic conditions associated with the deposit, and any other information that may be necessary to prepare a complete resource evaluation of the land.

(n) "Exploration license" means a license issued by the authorized officer to permit the exploration of Federally owned coal deposits under terms and conditions that will protect the surface and subsurface resources and the environment, and provide for the reclamation of the area disturbed by such exploration.

(o) "Exploration plan" means a detailed plan showing the location and type of exploration work to be conducted, environmental protection procedures, present and proposed roads, and reclamation and abandonment procedures to be followed upon completion of exploration operations.

(p) "Fair market value" means that amount in cash, or on terms reasonably equivalent to cash, for which in all probability the property would be sold by a knowledgeable owner willing but not obligated to sell to a knowledgeable purchaser who desires but is not obligated to buy. The Department shall consider various factors, such as payments to private surface holders for consent to enter and mine, when determining fair market value.

(q) "Governmental entities" means Federal and State agencies and municipalities and their subdivisions, including any corporation acting primarily as an agency or instrumentality of a State, which produces electrical energy for sale to the public.

(r) "Grant of modifications" means the Secretary's approval of a lease for additional coal lands or deposits in an existing coal lease or leases if these lands or deposits are contiguous to the modified lease. The total area added by modifications after August 4, 1976 cannot exceed 160 acres per lease or the acreage in each original lease, whichever is less.

(s) "Interest" in the lease or bid means: record title interests, overriding royalty interests, working interests; operating rights or options; or any agreements covering such an interest; any claim or

any prospective or future claim to an advantage or benefit from a lease; and any participation or any defined or undefined share in any increments, issues, or profits that may be derived from or that may accrue in any manner from the lease based on or pursuant to any agreement or understanding existing when the application was filed or entered into while the application or bid is pending.

(t) "Intertract bidding competition" means a lease sale method where tracts containing more reserves in total than the Department intends to lease in that sale are offered for sale. The winning bidders, if any, are selected by determining firstly the tract with the single highest bid per ton of reserves among all tracts, secondly the tract with the second highest bid and so forth. The bids may be weighted to compensate for differences in the physical quality of the coal in such tracts. If leases are awarded they shall be awarded for tracts proceeding in this sequence until the total reserve tonnage sought to be leased in that sale has been reached. Tracts receiving lower bids per ton and not needed to reach the total reserve objective for the sale shall not be leased in that sale. No lease shall be issued for a bid of less than fair market value.

(u) "Known Recoverable Coal Resource Area (KRCRA)," means, an area determined by the U.S. Geological Survey, where data is believed to be sufficient to evaluate the extent, depth, quality, and potential for development of coal that is technically recoverable based on past and current mining practices in the area. Boundaries for such an area show only the extent of recoverable Federally owned coal which is subject to leasing and are based on data available at the time of determination. These areas are formally designated and published in the FEDERAL REGISTER.

(v) "Licensed land" means land from which coal is removed in accordance with 30 U.S.C. 208.

"Logical Mining Unit (LMU)" means an area of coal land that can be developed and mined in an efficient, economical, and orderly manner with due regard for the conservation of coal reserves and other resources. An LMU may consist of one or more Federal leaseholds and may include intervening or adjacent non-Federal lands, but all lands in an LMU must be contiguous, under the effective control of a single operator, and capable of being developed and operated as a unified operation with complete extraction of the LMU reserves within 40 years from the date of first approval of a mining plan for that LMU. No LMU approved after August 4, 1976, shall exceed 25,000 acres, including both Federal and non-Federal coal deposits.

(x) "Logical Mining Unit Reserves" means the sum of (1) estimated recoverable reserves under Federal lease in the LMU, and (2) estimated non-Federal recoverable reserves in the LMU. The LMU reserves associated with a Federal lease are the LMU reserves estimated as of the effective date of the LMU, of which that lease is a part, except that the LMU reserves of this section may be adjusted by the Mining Supervisor whenever he approves a modification of the LMU boundaries, whenever the lessee surrenders deposits subject to the LMU, or whenever significant new information becomes available concerning the amount of such reserves, including the time when a mining plan is approved.

(y) "Maximum economic recovery (MER)" means the amount of coal that can be recovered by prudent mining practices from all seams that are collectively profitable to be mined on any tract evaluated for leasing at the time of the MER determination. Social and environmental costs shall be considered in determining profitability.

(z) "Mining method evaluation" means a written comparison of mining method alternatives used to determine maximum economic recovery.

(aa) "Mineral leasing laws" means the Mineral Leasing Act of 1920, as amended, (30 U.S.C. 181 et seq.) and the Mineral Leasing Act for Acquired Lands of 1947 (30 U.S.C. 351-359).

(bb) "Mining plan" means a completed mining and reclamation plan that complies with the requirements of the Mineral Leasing Act

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of 1920 as amended; the Surface Mining Control and Reclamation Act of 1977; and all other applicable laws.

(cc) "Mining Supervisor" means the Area Mining Supervisor, Conservation Division's, U.S. Geological Survey, or District Mining Supervisor or a subordinate acting under the Supervisor's direction.

(dd) "Operator" means a lessee, licensee or one conducting operations on a coal lease area under the authority of the lessee or licensee.

(ee) "Participate" means to have or take part or share with others in an exploration license.

(ff) "Permit" means the document issued for surface coal mining and reclamation operations on Federal lands after approval of a mining plan by the Director of the Office of Surface Mining, Reclamation, and Enforcement or, where a cooperative agreement pursuant to section 523 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1273) has been executed, the State regulatory authority (30 CFR PART 741)

(gg) "Permit area" means the area, including all natural and human resources, included within the boundaries specified in a permit, whether or not the areas will be impacted by surface coal mining and reclamation operations, which is designated on the approved maps submitted by the applicant with his permit application and covered by the performance bond required by 30 CFR 800-808.

(hh) "Preliminary tract" means an area containing technically recoverable coal that will feasibly support a commercial mining operation. The coal may either be owned by the Federal Government or be in a mixed ownership pattern. All Federal coal within the delineated area may be offered as a single tract in the same lease sale.

(ii) "Public bodies" means Federal and State agencies, municipalities, rural electric cooperatives and similar organizations, and nonprofit corporations controlled by any such entities.

(jj) "Reasonable amount of coal for analysis and study" means only that amount of coal that can be removed without causing substantial disturbance to the natural land surface, and that is necessary to establish whether or not a federally-owned coal deposit can be economically extracted.

(kk) "Secretary" means the Secretary of the Interior or his authorized representative.

(ll) "Sole party in interest" means a party who is and will be vested with all legal and equitable rights under a lease, bid, or an application for a lease. No one is, or shall be considered, a sole party in interest with respect to a lease or bid in which any other party has any interest.

(mm) "Split estate" means land in which the ownership of the surface is held by persons, including governmental bodies, other than the Federal government and the ownership of underlying mineral or coal deposits is reserved to the Federal government.

(nn) "Substantial disturbance to the natural land surface" means any disturbance other than that necessary for locating potential coal deposits and for obtaining the access to those coal deposits necessary to determine their location and quality. Permissible disturbance would include such operations as surface sampling or drilling, geologic study, and exploration holes. These operations shall extend only to the degree and extent necessary to determine the nature of the overlying strata and the depth, thickness, shape, grade, and quality of the coal deposit.

(oo) "Substantial legal and financial commitments" means major investments of money in power plants, railroads, coal handling and storage facilities and other capital intensive improvements, and fixed equipment made on the basis of long-term, legally enforceable coal sales contracts. Investments are "major" if they are substantial in relationship to the aggregate capital expenditures which reasonably can be anticipated to be made for capital improvements and fixed equipment at the mine site up to and including completion of all reclamation operations. Costs of the acquisition of the coal in place or of the right to mine it do not alone constitute "substantial legal and financial commitments."

(pp) "Surface management agency" means the Federal agency with jurisdiction over the surface of Federally owned lands containing coal deposits.

(qq) "Surface Mining Office" means the field representative authorized to act for Director of the Office of Surface Mining, Reclamation and Enforcement.

(rr) "Surface mining operation" means activities conducted on the surface of the lands in connection with a surface coal mine or surface operations and surface impacts incident to an underground mine.

(ss) "Surface owner" means the natural person or persons (or corporation, the majority stock of which is held by a person or persons) who:

(1) Hold legal or equitable title to the land surface;

(2) Have their principal place of residence on the land, or personally conduct farming or ranching operations upon a farm or ranch unit to be affected by surface mining operations; or receive directly a significant portion of their income, if any, from such farming and ranching operations; and

(3) Have met the conditions of (1) and (2) above for a period of at least 3 years prior to the granting of any consent to mining of their lands.

(4) In computing the three year period the State Director may include periods during which title was owned by a relative of such person by blood or marriage during which period such relative would have met the requirements of this subsection.

(tt) "Written consent" means the document or documents that the surface owner has signed that: (1) permit a coal operator to enter and commence surface mining; (2) describe any financial considerations given or promised in return for the consent, including in-kind considerations; (3) describe any considerations given in terms of type or method of operation or reclamation for the area; (4) contain any supplemental or related contracts between the surface owner and any other person party to the consent; and (5) contain a full and accurate description of the area covered by the consent.

§3400.1 Multiple Development.

The granting of a permit, license, or lease for the prospecting, development, or production of deposits of any one mineral will neither preclude the issuance of other permits or leases for the same land for deposits of other minerals with suitable stipulations for simultaneous operation, nor preclude the allowance of applicable entries, locations, or selections of leased lands with a reservation of the mineral deposits to the United States.

§3400.2 Lands subject to leasing.

The Secretary may issue coal leases on all lands owned by the United States except lands in the:

(a) National Park System;

(b) National Wildlife Refuge System;

(c) National Wilderness Preservation System;

(d) National System of Trails;

(e) National Wild and Scenic Rivers System, including study rivers designated under section 5(a) of the Wild and Scenic River Act;

(f) Incorporated cities, towns, and villages;

(g) Tide lands, submerged coastal lands within the Continental Shelf adjacent or littoral to any part of land within the jurisdiction of the United States;

(h) Land acquired by the United States for the development of mineral deposits, for foreclosure or otherwise for resale, or reported as surplus property pursuant to the provisions of the Surplus Property Act of 1944; and

(i) Naval Petroleum Reserves, the National Petroleum Reserve in Alaska, and oil shale reserves.

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§3400.3 Limited authority to lease.

§3400.3-1 Consent of administering agency.

Coal leases for land, the surface of which is under the jurisdiction of any Federal agency other than the Department of the Interior, may be issued only with the consent of the head or other appropriate official of the executive Branch, independent establishment, or instrumentality having jurisdiction over the lands containing the coal deposits or holding a mortgage or deed of trust secured by such lands. Coal exploration licenses, coal leases, and coal licenses to mine for such lands shall be subject to such conditions as that official may prescribe with respect to the use and protection of the nonmineral interest in the lands.

§3400.3-2 Department of Defense lands.

The Secretary may issue coal leases with the consent of the Secretary of Defense on acquired lands set apart for military or naval purposes only if the leases are issued to a governmental entity which

- (a) produces electrical energy for sale to the public;
- (b) is located in the State in which the leased lands are located; and
- (c) has production facilities in that State, and will use the coal produced from the lease within that State.

§3400.3-3 Department of Agriculture lands.

(a) The Secretary may issue coal leases with the consent of the Secretary of Agriculture on lands administered by the Forest Service.

(b) The Secretary may issue coal leases that authorize surface coal mining operations on Federal lands within a national forest except the Custer National Forest where:

(1) he finds that there are no significant recreational, timber, economic or other values which may be incompatible with the surface mining operations; and

(2) either (i) the surface operations are incident to an underground coal mine; or (ii) the Secretary of Agriculture determines (on lands west of the 100th meridian that do not have significant forest cover) that surface mining complies with the Multiple-Use-Sustained Yield Act of 1960, the Federal Coal Leasing Amendments Act of 1976, the National Forest Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977.

(c) The Secretary may not issue coal leases that would authorize surface coal mining operations on Federal lands within the boundaries of the Custer National Forest.

§3400.3-4 Trust protection lands.

The regulations in Group 3400 of Title 43 CFR do not apply to the leasing and development of coal deposits owned by Indians and subject to the trust protection of the United States. Regulations governing those deposits are found in 25 CFR chapter I.

PART 3410 - EXPLORATION LICENSES

Subpart 3410 - Coal Exploration Licenses

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3410.4 Use of data.

3410.5 Use of surface.

AUTHORITY: 30 U.S.C. 181 et seq.

Subpart 3410 - Coal Exploration Licenses

§ 3410.0-1 Purpose.

This Subpart provides for the issuance of licenses for exploring Federally owned coal deposits subject to disposal under Group 3400 regardless of surface ownership.

§ 3410.0-2 Objective.

The objective of this subpart is to allow private parties singularly or jointly to explore Federally owned coal deposits to obtain

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geological, environmental, and other pertinent data concerning the coal deposits and the lands in which they lie.

§ 3410.0-3 Authority.

These regulations are issued under the authority of section 2(b) of the Mineral Leasing Act of 1920, as amended by section 4 of the Federal Coal Leasing Amendments Act of 1976 (30 U.S.C. 201(b)).

§ 3410.0-4 Responsibilities.

(a) The Bureau of Land Management exercises the Secretary's discretionary authority to determine whether coal exploration licenses are to be issued. The Bureau is also responsible for issuing and cancelling exploration licenses and terminating the period of liability of the licensee under any bonds he may have posted as a condition of license issuance. The regulations in this Subpart shall be administered by the Director of the Bureau of Land Management through the State Director and the authorized officer, subject to the supervisory authority of the Secretary. The Bureau of Land Management State Office having jurisdiction over the lands involved is also the Office of Record (43 CFR Subpart 1821).

(b) The Geological Survey exercises the Secretary's authority regarding operations conducted within the area covered by the licensee, including responsibility for all geological, economic, and engineering determinations.

(c) The authorized officer, in consultation with the Geological Survey, and where appropriate, the surface management agency and the surface owner, if other than the United States, formulates the requirements to be incorporated in coal exploration licenses for the protection of the surface resources and for reclamation. In developing guidelines and bonding requirements, the authorized officer shall use the surface operating and reclamation performance standards in 30 CFR Part 211.

(d) The Geological Survey, after consultation with the authorized officer, and where appropriate, the surface management agency and the surface owner if other than the United States, shall provide technical review and concur with or recommend appropriate changes in the exploration plans. Upon the completion of exploration operations, the Geological Survey shall recommend termination of the period of the licensee's liability under any bond posted.

§ 3410.1 Lands subject to coal exploration licensing.

(a) Coal exploration licenses may be issued for:

(1) Lands administered by the Secretary that are subject to leasing, Section 3400.2; administered by the Secretary of Agriculture through the Forest Service that are subject to leasing, Section 3400.2;

(3) Coal deposits in lands which have been conveyed by the United States subject to a reservation to the United States of the mineral or coal deposits, to the extent that those deposits are subject to lease under regulations in Section 3400.2; and

(4) Coal or lignite deposits in acquired lands set apart for military or naval purposes.

(b) No coal exploration license shall be issued for land on which a coal lease has already been issued.

§ 3410.2 Prelicensing procedures.

§ 3410.2-1 Environmental review.

Before a coal exploration license may be issued:

(a) The authorized officer, using the exploration plan submitted by the applicant, shall make an assessment of the potential effect of such exploration on the area and its environment. Aspects of the environment to be examined include surface and groundwater; fish and other aquatic resources; wildlife habitats and populations; visual resources; recreational resources; cultural resources; and social factors in the affected area.

(b) If the authorized officer determines that an environmental statement is required by Section 102(2)(c) of the National Environmental Policy Act of 1969 (43 U.S.C. 4332(2)(c)), a statement shall be prepared.

§ 3410.2-2 Cultural resources

If lands in the National Register or nominated for inclusion in the National Register contain cultural resources which might be affected by an action taken under a coal exploration license, no license for such lands shall be authorized until after compliance with section 106 of the Historic Preservation Act (16 U.S.C. 470f). Other cultural resource values shall also be protected pursuant to Section 106 of the Historic Preservation Act.

§ 3410.2-3 Threatened or endangered species.

If threatened or endangered species of fauna or flora or their critical habitat would be destroyed or adversely modified by the issuance of a coal exploration license, no license for such lands shall be authorized. In making this determination the authorized officer shall consult the Federal surface management agency, if other than Bureau of Land Management, and if the presence of threatened or endangered species or their habitat is suspected or known, he shall consult with the Fish and Wildlife Service in accordance with 50 CFR PART 402.

§ 3410.2-4 Surface management agency.

The authorized officer may issue a coal exploration license covering lands the surface of which is under the jurisdiction of any Federal agency other than the Bureau of Land Management only in accordance with those conditions prescribed by the surface management agency concerning the use and protection of the nonmineral interests in those lands.

§ 3410.2-5 Substantial disturbance to the environment.

No coal exploration license shall be issued if the actions taken under the license would result in substantial disturbance to the natural environment.

§ 3410.3 Coal exploration licenses.

§ 3410.3-1 Applications for a coal exploration license.

(a) Coal exploration license applications shall be submitted at the Bureau of Land Management State Office having jurisdiction over the lands covered in the application (43 CFR Subpart 1821). The applications shall be subject to the following requirements:

(1) No specified form of application is required.

(2) The tract or tracts to be explored shall be described by legal description or, if on unsurveyed lands, by metes and bounds.

(3) Each application shall contain three copies of an exploration plan which complies with the requirements of 30 CFR 211.10(a).

(4) Each application and its supporting documents shall be filed with a nonrefundable filing fee (43 CFR 3473.2).

(5) Coal exploration license applications shall normally cover no more than 25,000 acres in a reasonably compact area and entirely within one State. Applications for more than 25,000 acres must include a justification for an exception to the normal acreage limitation.

(b) Any person qualified to hold leases under the provisions in Subpart 3472 of this chapter may apply for a coal exploration license.

(c) Nothing in this Subpart shall preclude the authorized officer from issuing a call for an expression of interest in coal exploration licenses for a given area.

(d) Applicants for coal exploration licenses shall be required, prior to license issuance, to provide an opportunity for other parties to participate in exploration under the license on a pro rata cost sharing basis. Upon notice that a license will be issued, an applicant shall

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publish a "Notice of Invitation," approved by the authorized officer, once every week for four consecutive weeks in at least one newspaper of general circulation in the area where the lands covered by the license application are situated. This notice shall contain an invitation to the public to participate in the exploration under the license. Copies of the Notices of Invitation shall be filed with the authorized officer two weeks prior to publication by the applicant, for posting in the proper Bureau of Land Management Office and for Bureau of Land Management publication of the Notice of Invitation in the FEDERAL REGISTER. Any person who elects to participate in the exploration program shall notify the authorized officer and the applicant in writing within 2 weeks after the final publication. The authorized officer may require modification of the original exploration plan to accommodate the needs of additional participants.

(e) An application to conduct exploration which could have been conducted as a part of exploration under an existing coal exploration license may be rejected.

§ 3410.3-2 Issuance and termination of a coal exploration license.

(a) No person may explore without a lease unless a coal exploration license has been issued. A coal exploration license shall not be required for "casual use" as defined in 30 CFR 211.10(a). The authorized officer has discretionary power in issuing coal exploration licenses under this Subpart.

(b) A coal exploration license shall become effective on the date specified by the authorized officer as the date when exploration activities may begin. A coal exploration license shall not be valid for more than two years from its effective date. Cleanup and restoration must be completed during this period.

(c) Subject to the continued obligation of the licensee and the surety company to comply with the terms and conditions and special stipulations of the license, the plan, and the regulations, a licensee may relinquish an exploration license for all or any portion of the lands included under the license. A relinquishment shall be filed in the Bureau of Land Management State Office in which the original application was filed. See 43 CFR Subpart 1821.

(d) An exploration license may be revoked by the authorized officer for noncompliance with the terms of the license, the plan, or the regulations, after the authorized officer has notified the licensee of the violation(s) in writing and the licensee has failed to correct the violations within the period prescribed in the notice.

(e) An exploration plan shall be dated, attached, and made a part of each license issued. Issuance of the license constitutes approval of the exploration plan.

(f) When unforeseen conditions that could result in significant disturbance or damage to the environment are encountered, or when geologic or other physical conditions warrant a modification in the approved exploration plan, (1) the authorized officer, after consultation with the Mining Supervisor and, where appropriate, the surface management agency, may adjust the terms and conditions of the license, or (2) the Mining Supervisor, after consultation with the authorized officer and, where appropriate, the surface management agency, may approve changes in the exploration plan.

(g) Coal exploration licenses shall not be extended. Exploration operations may not be conducted after a license has expired. The licensee may apply for a new license as described in Section 3410.3-1. A new license may be issued simultaneously with the termination of the existing license.

(h) Any person who willfully conducts coal exploration on lands subject to this Subpart without an exploration license shall be subject to the provisions of Subpart 9239.5-3(f) of this chapter.

§ 3410.3-3 Rights under coal exploration licenses.

(a) The issuance of a coal exploration license shall confer the right to perform exploration operations in accordance with the specific terms and conditions of the license, the approved exploration plan, and these regulations.

(b) The issuance of coal exploration licenses shall not preclude the issuance of coal leases under applicable regulations. If a coal lease is issued for lands included in a coal exploration license, those lands which are common to both shall be eliminated from the coal exploration license upon the effective date of the lease.

(c) The issuance of a coal exploration license shall not vest in the licensee an exclusive right to explore on the licensed lands or any preferential right to a lease.

(d) A licensee may not remove for sale any coal from the deposits subject to the license. A reasonable amount of coal may be removed for analysis and study provided such removal is in compliance with the exploration plan under which the license was granted. This reasonable amount of coal shall normally be considered as a quantity up to 250 tons although an exemption may be granted if appropriately justified.

§ 3410.3-4 Operating regulations.

The licensee shall comply with the provisions of the operating regulations of the Geological Survey (30 CFR Part 211). Copies of the operating regulations may be obtained from the Mining Supervisor. Authorized representatives of the Secretary and, where appropriate, any surface management agency shall be permitted to inspect the premises and operations. The licensee shall provide for the free ingress and egress of Government officers and other persons using the lands under authority of the United States.

§ 3410.3-5 Surface protection and reclamation.

(a) The authorized officer shall include in each coal exploration license requirements and stipulations to protect the environment and associated natural resources and to ensure reclamation of the land disturbed by exploration.

(b) The exploration plan shall be designed to prevent substantial disturbance of the natural land surface.

§ 3410.3-6 Ground and surface water data.

The applicant may be required to collect and report ground and surface water data to the authorized officer.

§ 3410.3-7 Bonds.

(a) Bonding provisions in Subpart 3474 of this chapter apply to these regulations.

(b) Prior to issuing a coal exploration license, the authorized officer, after consultation with the Mining Supervisor and, where appropriate, the surface management agency and the surface owner, shall insure that the amount of the bond or bonds to be furnished is sufficient to insure compliance with the terms and conditions of the license and regulations. In no event shall the amount of such bond be less than \$5,000.

(c) Upon completion of exploration and reclamation activities that are in compliance with the terms and conditions of the coal exploration license, the approved exploration plan, and the regulations, or upon discontinuance of exploration operations and completion of such reclamation as may be needed to the satisfaction of the authorized officer and, where appropriate, the surface management agency, the authorized officer shall terminate the period of liability of the compliance bond. Where the surface of the land being explored is privately owned, the authorized officer shall not terminate the period of liability under the compliance bond until the surface owner has notified the authorized officer, in writing, that the surface has been reclaimed in a satisfactory manner. Should the licensee and surface owners be unable to agree on the adequacy of the reclamation, the authorized officer shall make the final determination. The period of liability under the compliance bond shall be terminated after it is determined that the terms and conditions and special stipulations of the coal exploration license, the approved exploration plan, and the regulations have been met.

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§ 3410.4 Use of data.

The licensee shall furnish to the Mining Supervisor copies of all data (including but not limited to, geological, geophysical, and core drilling analyses) obtained during exploration. The licensee shall submit such data and, where appropriate, the methods by which the data were gathered, at such time and in such form as required by the Mining Supervisor, the authorized officer, or surface management agency, or as specified in this Subpart, the license, or the plan. All data shall be considered confidential until the areas involved have been leased or until the Mining Supervisor determines that public access to the data would not damage the competitive position of the licensee, whichever comes first. (30 CFR 211.6; 43 CFR 2.20).

§ 3410.5 Use of surface.

(a) A licensee shall be entitled to use for exploration purposes only that surface area of the licensed lands that is authorized in the approved exploration plan.

(b) Operations under these regulations shall not unreasonably interfere with or endanger operations authorized under any other Act or regulation.

(c) The licensee shall comply with all applicable Federal, State and local laws and regulations, including the regulations in Group 3000 and Part 3460 of this chapter, and 30 CFR Parts 211 and 741.

PART 3420 - COMPETITIVE LEASING

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AUTHORITY: 30 U.S.C. 181 et seq; 30 U.S.C. 351-359; 30 U.S.C. 521-531; 30 U.S.C. 1201 et seq.; 42 U.S.C. 7101 et seq.; 43 U.S.C. 1701 et seq.; and 15 U.S.C. 634-644

Subpart 3420 - Competitive Leasing

§ 3420.0-1 Purpose.

This subpart sets forth the procedures for the competitive leasing of Federal coal.

§ 3420.0-2 Objectives.

The objectives of these regulations are to establish standards and procedures for considering and, where appropriate, causing development of Federally owned coal through a leasing system involving land use planning and environmental assessment processes; to ensure that an adequate supply of Federal coal is developed efficiently in compliance with laws, planning processes, and other safeguards designed to protect society and the environment; to ensure that Federal coal is leased at its fair market value; and to ensure that Federal coal is developed in consultation, cooperation, and coordination with the public, State and local governments, and involved Federal agencies.

§ 3420.0-3 Authority.

Regulations in this Part are issued under the authority of:

- (a) The statutes cited in Section 3400.0-3 of this chapter; and
- (b) The Small Business Act of 1953, as amended (15 U.S.C. 631 et seq.).

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§ 3420.0-6 Policy.

All coal leases except those issued under the provisions of Subparts 3430 and 3440 shall be issued only after competitive bidding. There shall be special opportunity coal lease sales for qualified public bodies and for small businesses. The fair market value determinations for special opportunity coal lease sales shall be derived in the same manner as for other coal lease sales. Before each sale, the Department shall evaluate and compare the method or methods of mining that will achieve the maximum economic recovery of the coal resource. The Department shall receive fair market value for all coal leased.

§ 3420.1 Procedures.

§ 3420.1-1 General.

The competitive leasing program is part of a Federal coal management program and consists of four principal elements; comprehensive multiple resource land use planning; establishment of production targets; specific tract identification, ranking selection, and scheduling; and lease sale. The application of criteria for unsuitability for leasing is an integral part of land use planning. All competitive lease sales, except those held under emergency leasing criteria, shall be initiated by the Secretary.

§ 3420.1-2 Lands subject to evaluation for leasing.

(a) All lands subject to coal leasing under the mineral leasing laws are subject to evaluation under this Subpart (43 CFR 3400.2).

§ 3420.1-3 Known Recoverable Coal Resource Areas.

No areas outside Known Recoverable Coal Resource Areas (KRCRAs) shall be leased.

§ 3420.1-4 Special leasing opportunities.

(a) The Secretary shall, under the procedures established in this Subpart, reserve and offer a reasonable number of coal lease tracts as special leasing opportunities. Except for the limitation on bidding contained in paragraph (b) of this Subpart, all requirements in this Subpart apply to special leasing opportunities, including the requirement that coal be leased at its fair market value.

(b) Special leasing opportunities shall involve two classes of bidders.

(1) Public bodies.

(i) Only public bodies with a definite plan for producing energy for their own use or for two or more of their members or customers shall bid for leases designated as special leasing opportunities for public bodies.

(ii) Public bodies shall submit evidence of qualification as part of their expression of leasing interest or upon submission of a bid if no expression of interest is made.

(iii) The Secretary may designate certain coal lease tracts as special leasing opportunities for public bodies only if a public body has requested, in the planning or specific tract identification process or elsewhere, that the procedures of this section apply. Leases issued under this section to public bodies may be assigned only to other public bodies.

(2) Small business.

(i) When necessary to comply with the requirements of the Small Business Administration Act, the Secretary shall designate a reasonable number of tracts for special leasing opportunities for businesses qualifying under 13 CFR Part 121.

(ii) Leases issued under this section may be assigned only to other small businesses qualifying under 13 CFR PART 121.

§ 3420.1-5 Requirements for land use planning.

(a) The Secretary may not issue a lease for coal deposits unless the lands containing coal deposits have been included in a comprehensive land use plan or land use analysis and unless the sale

is compatible with the plan. Plans shall be prepared in accordance with the multiple use and sustained yield principles set forth in the Federal Land Policy and Management Act of 1976, or under the planning requirements applicable to any Federal agency with surface management authority over lands subject to leasing. All lands administered by a Federal agency containing Federal coal, regardless of surface ownership, shall be evaluated by this process.

(b) In an area where the Secretary finds that there is no Federal interest in the surface or that coal resources in an area are insufficient to justify the costs of a Federal comprehensive land use plan, and as a result decides not to prepare a Federal comprehensive land use plan, lands may be leased if the lands containing the coal deposits have been included under one of the alternative actions discussed below.

(1) Leasing may occur if the lands have been included in a comprehensive land use plan prepared by the State. The recommendations of those plans shall govern Federal coal leasing recommendations affecting surface management except those decisions for which the Secretary is responsible under the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.) and those recommendations that are in conflict with Federal law.

(2) Leasing may occur if the lands have been included in a land use analysis completed under the provisions of Group 1600 of this chapter.

(c) The Department of Agriculture and other Federal agencies with jurisdiction over lands which contain Federal coal are responsible for land use planning for those lands.

§ 3420.2 Land use plans prepared by the Bureau of Land Management.

§ 3420.2-1 Preparation of a land use plan.

The Bureau of Land Management shall prepare land use plans and land use analyses as provided in Group 1600 of this chapter.

§ 3420.2-2 Coal resource information.

A land use plan shall contain an assessment of the amount of coal recoverable by either surface or underground mining operations or both.

§ 3420.2-3 Lands acceptable for further consideration for leasing.

The major land use planning decision relating to the coal resource shall be the delineation of areas acceptable for further consideration for leasing. The areas acceptable for further consideration for leasing shall be identified by the following screening procedures.

The screening factors listed below shall be applied in sequence and each factor shall be applied only to those lands not eliminated by consideration of the previous factor(s).

(a) Only those areas subject to evaluation for leasing (Section 3420.1-2) that have high or moderate development potential shall be considered acceptable for further consideration for leasing. This determination shall be based on the Geological Survey's Coal Resource Occurrence/Coal Development Potential (CRO/CDP) maps. If CRO/CDP maps are not available, the Geological Survey shall use other available data sources to estimate development potential. If other data sources are used, the same criteria for designating coal reserves as high or moderate development potential shall be used.

(b) In accordance with the provisions and standards of Section 522 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1272), and the President's environmental message of May 1977, the authorized officer shall, using the unsuitability criteria and procedures set out in subpart 3461 review the Federal lands to determine where there are areas unsuitable for all or certain types of coal mining. Areas considered unsuitable for all types of mining shall not be considered acceptable for further consideration for leasing.

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(1) On Federal lands administered by the Bureau of Land Management, an unsuitability determination will be made as part of the land use planning process using both environmental and resource management criteria of the Bureau and reclamation and environmental criteria developed by the Office of Surface Mining Reclamation and Enforcement.

(2) In cases where land use plans to be used for coal leasing have been prepared by other Federal agencies or State Governments and do not contain an unsuitability assessment, the Secretary shall conduct an assessment prior to lease sale. This assessment shall provide opportunity for public comment.

(c) Multiple land use decisions may be made eliminating coal areas from further consideration for leasing to protect other resource values of a unique, site-specific nature not included in the unsuitability criteria discussed in paragraph (b) of this subsection.

(d) While preparing a land use plan the Bureau of Land Management shall consult with all surface owners, as defined in Section 3400.0-5 of this chapter, whose lands overlie Federal coal to determine their preference for or against coal mining by other than underground mining techniques.

(1) If the surface owner indicates a definite preference against the leasing of the portion of a deposit underlying his private surface for mining by other than underground techniques, and signs a written statement that he has not granted any options, preferences or rights of first refusal to acquire consent to any other party, that portion of the deposit may be designated not acceptable for further consideration for leasing for mining by methods other than underground mining techniques. Should the surface owner not wish to have the deposit eliminated from further consideration, the owner shall still retain the right to veto leasing of the coal deposit under his surface for mining by other than underground mining techniques, at the time surface owner consent is sought under Subpart 3427.

(2) Where a significant number of surface owners have expressed a preference against leasing but an economic amount of Federal coal still remains for further consideration in the area after eliminating the objecting surface owners' portions of the deposit as provided for in paragraph (1), the area shall be specially noted in the land use documentation and shall not be offered for lease sale for development by other than underground mining techniques unless there are no acceptable alternative areas available to meet production targets within the production region.

(e) The land planning agency may recommend maximum levels or rates of coal development for the areas designated acceptable for further consideration for leasing.

§ 3420.2-4 Hearing Requirements.

The Bureau of Land Management shall conduct a public hearing on the proposed plan before it is adopted if such a hearing is requested by any person who may be adversely affected by the adoption of the plan.

The authorized officer conducting the hearing shall:

(a) publish a notice of the hearing in a newspaper of general circulation at least once in each of two consecutive weeks in the affected geographical area;

(b) provide an opportunity for testimony by anyone who desires to do so; and

(c) record the proceedings of the hearing so that a complete transcript of the hearing can be compiled if requested.

§ 3420.2-5 Consultation with Federal surface managing agencies.

In situations where another Federal surface managing agency administers limited areas overlying Federal coal within the boundaries of a comprehensive land use plan being prepared by the Bureau of Land Management, the Bureau of Land Management shall consult with the other agency to obtain its recommendations as to the acceptability for further consideration for leasing of the land the other agency administers.

§ 3420.2-6 Consultation with States.

Before making formal determination of lands acceptable for further consideration for leasing, the Bureau of Land Management shall consult with the State Governor and the State agency charged with the responsibility for maintaining the state's unsuitability program (43 CFR 3461.4-1).

§ 3420.3 Regional production targets.

§ 3420.3-1 General.

The Secretary in consultation with the Secretary of the Department of Energy, affected State Governors, and other concerned parties shall establish regional coal production targets for the purposes of setting Departmental priorities, aiding the States in planning for potential future impacts of coal development, and supplying guidance for establishing proposed coal sale schedules. The regional production targets shall not be considered in establishing the areas acceptable for leasing discussed in Section 3420.2-3.

§ 3420.3-2 Evaluation of coal needs.

(a) The Secretary shall first propose preliminary total coal production targets for each designated region, using various data sources, including the Department of Energy's coal production forecasts. The Secretary shall then assess the need for new Federal coal leasing to meet the total regional production targets and shall then propose regional new leasing production targets. The regional new leasing production targets shall include both Federal and non-Federal production to come from logical mining units consisting in all or part of new Federal leases. The total regional coal production and regional new leasing production targets shall be for 5, 10, and 15 years. In estimating regional new leasing production targets the expected and potential production from existing Federal coal leases, noncompetitive coal lease applications, and non-Federal coal holdings shall be evaluated. Preliminary regional targets for coal production shall reflect the difference between projected coal demand and supplies. Consideration shall also be given to the relative economic, social, and environmental differences among the coal regions, the benefits of developing Federal versus non-Federal coal, and other factors.

(b) The Secretary shall discuss the preliminary regional coal production targets with the Governors of affected States seeking their views about the adequacy of the estimates and suggested revisions. The Secretary shall particularly seek the Governors' views regarding the relationship between the regional production targets and potential social economic considerations.

(c) The coal industry, agricultural and community organizations environmental groups, and other concerned parties shall be given an opportunity to submit their views on the preliminary regional coal production targets.

(d) After the consultation period, the Secretary may revise, as necessary, the preliminary regional production targets in response to comments received.

(e) The Secretary shall review and if necessary revise regional coal production targets every two years. The targets and supporting analysis shall be made available to the public.

(f) The establishment of regional production targets shall not prevent the Secretary from accepting and accommodating specific needs in emergency leasing situations.

§ 3420.3-3 Use of regional production targets.

The regional production targets shall be used to establish priority planning areas and to guide budget and personnel planning and Federal coal exploration programs. These targets do not represent final leasing decisions and may be changed as a result of industry needs and socioeconomic, environmental, and other factors taken into consideration during the ranking, selection, and scheduling process.

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§ 3420.3-4 Environmental assessment.

An environmental assessment in the form of an updating of the coal programmatic environmental impact statement shall be conducted by the Secretary if he:

(a) determines the regional production targets established in accordance with this section vary significantly from those analyzed in the most current version of the coal programmatic statement or

(b) has reason to believe that the tracts available for selection in the next round of the ranking, selection, and scheduling process (Section 3420.4-4) in any given region(s) may generate significantly different levels or types of environmental impacts than were anticipated in the most current coal programmatic statement.

§ 3420.4 Specific tract identification, ranking, selection, and scheduling (Activity Planning).

§ 3420.4-1 Identification process.

This section describes the process for identifying, ranking, selecting, and scheduling coal lease tracts after land use planning has been completed. This process constitutes the "coal activity planning" aspect of the overall coal management program. Coal activity planning occurs in those areas (a) (1) where areas acceptable for further consideration for leasing have been delineated in the Bureau of Land Management's land use planning process or (2) where other acceptable planning has been undertaken and (b) where coal leasing and development is not incompatible with previously existing plans once the unsuitability criteria have been applied in accordance with Subpart 3461 of this chapter.

§ 3420.4-2 Expressions of leasing interest.

(a) A call for expressions of leasing interest may be made after areas acceptable for further consideration for leasing have been identified through the Bureau of Land Management's planning process. A call for expressions of leasing interest may also be made in other areas having acceptable planning completed by other Federal agencies or State governments under the provisions of Section 3420.1-5. The call may be made in any one, several or all of the above mentioned areas when the Secretary determines that additional Federal coal may be needed to meet local, State, or national needs in the foreseeable future.

(b) The expressions of interest process provided for in this Subpart shall not prohibit any party from participating in the general public input processes available through the planning process.

(c) Any individual, business, industry, or public institution may express an interest in leasing when the Secretary issues a call for expressions of leasing interest.

(d) Qualifying entities for public body leasing as defined in Section 3420.1-4 of this part shall make their intentions known through an indication of leasing interest when called for by the Secretary.

(e) Any expressions of leasing interest may include nonproprietary data supporting the expression of interest. Such data may include, but are not limited to, location and quantities of coal desired, time frames, proposed use of coal, technical coal data, commitments with private surface and coal owners and adjacent landowners or lessees, and basic development proposals. Data which are considered proprietary shall not be submitted as part of the expression of interest.

(f) Public inspection and copying of information submitted under this Subpart shall be governed by the procedures in 43 CFR Part 2.

(g) Each request for an expression of leasing interest shall be published in the FEDERAL REGISTER and in at least one newspaper(s) of general circulation in the affected State. This notice of request shall specify the area or areas involved, information required, the time period within which expressions may be submitted,

where to write for further information, and where to submit the expressions,

§ 3420.4-3 Preliminary tract identification.

(a) The Secretary shall identify potential tracts based on the following factors:

(1) Technical coal data, including reserve tonnage, rank, sulfur content, seam thickness, and ratio of overburden to recoverable coal;

(2) Conservation considerations, including preliminary calculation of maximum economic recovery, land ownership patterns, and the potential formation of logical mining units;

(3) Expressions of interest and existing or planned operations on adjoining lands;

(4) Surface ownership, including the results of surface owner consultation, and the existence of written surface owner consents and their terms; and

(5) Other relevant factors.

(b) The Secretary shall identify the potential tracts in accordance with Section 3471.1 of this chapter or by seam(s) or coal bed(s), or both.

(c) When public bodies have expressed interest in leasing, tracts to meet those needs may be designated when and where technically feasible in accordance with Section 3420.1-4.

(d) In cooperation with the Small Business Administration, tracts may be designated when and where technically feasible for small business special opportunities in accordance with Section 3420.1-4.

(e) The Secretary may identify other tracts to be used in the lease exchange program (43 CFR Subpart 3435).

§ 3420.4-4. Regional Tract Ranking, Selection, and Scheduling.

(a) If the regional production target established for any given region suggests a need for additional Federal coal leasing, a proposed lease sale schedule shall be formulated. Before a schedule is established, all available tracts identified under the previous section within the region shall be analyzed and then ranked by priority using such criteria as coal economics, ease of reclamation, proximity to existing transportation facilities, surface owner preference, and socioeconomic and environmental considerations. In ranking the tracts, the positive opportunities to aid in development of other Federal resources in cooperation with Federal coal development should be taken into effect.

(b) The production potential of ranked tracts shall be compared with the regional production target and a set of tracts shall be selected for a proposed lease sale schedule. As the potential environmental and social impacts which would result from development of several tracts in the same area might be cumulative, the selection of one tract might lower the priority of other tracts in the same area. The selected tracts therefore may not directly correspond to the relative order in which the individual tracts were originally ranked. The relationships between sales scheduling considerations and environmental impacts shall be considered in developing the schedule. The number of tracts selected shall be dependent on the type of bidding system to be used (Section 3422.3-2) and the coal tonnage targeted for lease. The selected tracts shall then be placed into a proposed lease sale schedule.

(c) The following procedures shall be used in this process.

(1) The ranking, selection, and scheduling process shall be done by the authorized officer in close consultation with the Governor(s) within whose State(s) the region is located and in consultation with representatives of all affected Federal surface managing agencies. The authorized officer shall also solicit the recommendations of other Federal agencies having appropriate expertise, including the Fish and Wildlife Service, the Geological Survey, and the Office of Surface Mining Reclamation and Enforcement. The authorized officer shall involve the public, local communities, industry, and other interested parties before tract ranking and selection.

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(2) A notice of intent to rank and select tracts to be included in a proposed lease sale schedule shall be published in the FEDERAL REGISTER and selected newspapers of general distribution within the region no less than 30 days before the ranking process begins. The notice shall contain a description of the tracts to be ranked and procedures under which any interested parties may become involved in the process.

(3) The results of the process, including the tract rankings, the tracts selected, the proposed schedule, and the list of ranking criteria used shall be published in the environmental assessment prepared on the ranking, selection, and scheduling process (Section 3420.4-5). Detailed information on each of the tracts ranked will be available for inspection in the Bureau of Land Management offices that have jurisdiction within the region (43 CFR Subpart 1821). Those parties interested in commenting on the results of the tract ranking, selection and scheduling process shall have the opportunity to do so in the environmental assessment process, prior to any final decision by the Secretary to adopt a regional sale schedule including any of the selected tracts.

(4) The ranking, selection, and scheduling process shall normally be repeated every four years with an update performed every two years in accordance with any need identified by the updated regional production targets. The Secretary may, in consultation with the Governor(s) of the affected States and surface managing agencies, initiate or postpone the process to respond to considerations such as major planning updates, new preliminary tract identifications, and increases or decreases in the level of leasing.

(5) To establish planning and inventory related priorities, the authorized officer may include in the ranking process areas acceptable for further consideration for leasing in which preliminary lease tracts have not yet been defined. Provided all tracts subsequently identified for lease consideration are formally entered into the ranking, selection and scheduling process before they are included in a lease sale proposal, these areas may be treated informally: it is unnecessary to include them in the notices of intent and in the results discussed under paragraphs (b), (c)(2), and (c)(3) of this subsection.

§3420.4-5 Environmental assessment.

(a) In conjunction with the regional ranking, selection, and scheduling process, an environmental assessment of the proposed lease sale schedule and alternatives shall be prepared in accordance with the provisions of the National Environmental Policy Act of 1969. The assessment shall consider both:

(1) the site-specific potential environmental impacts of each tract being considered for lease sale; and

(2) the intraregional cumulative environmental impacts of the proposed leasing action and alternatives.

(b) The environmental assessment prepared for the original regional lease sale schedule shall be updated if the Department makes any significant alterations to that schedule not considered in the original environmental assessment.

§3420.4-6 Public meetings on proposed tracts.

After the draft regional environmental assessment has been completed and an initial decision on the tracts to be offered for lease has been made, a public meeting shall be held in the region affected to announce the results of the ranking, selection, and scheduling process; the proposed lease sale schedule; and the potential impacts, including proposed mitigation measures.

§3420.5 Final Consultations.

Following the release of the final regional environmental assessment, the Secretary shall formally consult with the State Governors of those States within which Federal coal lease sales are under consideration. The Secretary shall also consult with any surface management agency other than the Interior Department which

administers lands overlying any Federal coal lease tract under consideration.

§3420.5-1 Consultation with surface management agencies.

(a) the Secretary may not issue competitive leases for lands the surface of which is under the jurisdiction of any agency other than the Department of the Interior unless the Federal agency has consented to the issuance of the lease (43 CFR 3400.3-1). Any lease issued shall contain the terms and conditions that the head of the agency may prescribe for the use and protection of the nonmineral interests in those lands.

(b) The Secretary may prescribe additional terms and conditions that are consistent with the terms proposed by the surface managing agency to protect the interest of the United States and to safeguard the public welfare.

§3420.5-2 Consultation with Governor.

(a) Before adopting a regional lease sale schedule, the Secretary shall consult the Governor of the state in which the land to be leased is located. The Secretary shall give the Governor a specified period of time to comment, not less than 30 days or more than 60 days, before issuing a final decision regarding any potential Federal coal lease sale within the State.

(b) When a lease proposal would permit surface mining within the boundaries of a national Forest, the Governor of the State in which the land to be leased is located shall be so notified by the Secretary. If the Governor fails to object to the lease proposal in 60 days, the Secretary may issue the lease. If within the 60 day period the Governor notifies the Secretary, in writing, of an objection to the lease proposal, the Secretary may not approve the lease for six months from the date that the Governor objects to the lease. The Governor may, during this six-month period, submit a written statement of reasons why the lease should not be issued, and the Secretary shall, on the basis of this statement, reconsider the lease proposal.

§3420.6 Surface owner consent considerations.

Prior to making a final decision on a regional coal lease sale schedule, the Secretary shall give consideration to what acceptable written surface owner consents have been received for those potential coal lease sales tracts under consideration for inclusion in the regional coal lease sales schedule. The Secretary's considerations shall be given in accordance with the split estate leasing provision of Section 3427.

§3420.6-1 Announcement of tracts under consideration.

Following the release of the final regional coal lease sale schedule environmental assessment, the Secretary shall publish an announcement in the FEDERAL REGISTER containing:

(a) A legal description of all potential coal lease sale tracts under consideration for inclusion in the regional coal lease sale schedule, and

(b) the deadline for anyone to submit a written surface owner consent for any of the tracts for consideration by the Secretary in making his selection of the tracts to be included in the lease sale schedule.

§3420.6-2 Consideration of consents.

The Secretary shall, pursuant to Section 3427.2, take the existence of written surface owner consents into consideration in making his decision on the final regional coal lease sale schedule. All other ranking, selection, and scheduling factors being nearly equal, those tracts for which an acceptable written consent has been received shall be chosen for inclusion in the regional coal lease sale schedule over those for which no acceptable written consent has yet been received.

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3420.7 Adoption of final regional coal lease sale schedule.

3420.7-1 Announcement.

Following completion of the requirements of sections 3420.5 and 3420.6, the Secretary shall announce a final coal lease sale schedule. The announcement shall be published in the FEDERAL REGISTER and contain a legal description of each scheduled coal lease sale tract and the date when each lease sale tract has been tentatively scheduled.

3420.7-2 Revision.

(a) The Secretary may revise either the list of tracts included in the schedule or the timing of the lease sales in accordance with any alternatives considered during the regional coal lease sale schedule environmental assessment and during the consultation with the Governors and other surface management agencies if, due to changing conditions, it would be in the public interest. Notice of any such revision shall be published in the FEDERAL REGISTER.

(b) The entire schedule may be updated or replaced as a result of a new regional ranking, selection, and scheduling effort conducted in accordance with the provision of Section 3420.4-4.

Subpart 3422 - Lease Sales.

3422.1-1 Mineral evaluation.

When the regional lease sale schedule has been announced, the authorized officer shall request final mineral evaluation and mining method determinations from the Geological Survey. When the mineral evaluation request is received, the Geological Survey shall consider public comments of fair market value and available geotechnical, engineering and economic data, determine the coal resource economic value and the maximum economic recovery for the lease tract under consideration. The mineral evaluation includes the consideration of coal quality and quantity, probable mining method, costs, prices, logical mining units, and other appropriate elements. Prior to issuance of the sale notice the Geological Survey shall forward to the authorized officer the results of the mineral evaluation. These results shall include the coal resource economic value, mining method evaluation, estimated recoverable reserves, coal quality assessment, royalty bond recommendations, and reclamation fees that would be generated by mining the proposed lease.

3422.1-2 Fair market value determination.

When the coal resource economic value and accompanying information are received, the authorized officer shall use this information and assess the public comments to determine the fair market value of the proposed lease. Minimum bonus bids shall be \$25 per acre. Fair market value requirements shall be the same for special opportunity, emergency, and regular competitive leasing. All financial terms shall be the same for either entity. When fair market value has been determined, the authorized officer shall inform the Geological Survey of the determination.

3422.2 Notice of lease sale.

(a) Prior to the lease sale, the authorized officer shall publish a notice of the proposed sale in the FEDERAL REGISTER and in a newspaper(s) of general circulation in the county or equivalent political subdivision in which the lands are situated. The newspaper notice shall be published once a week for four consecutive weeks. Such notice shall also be posted in the Bureau of Land Management State Office and mailed to the owner of surface, if other than the United States, to appropriate Federal and State agencies, and to the clerk or other appropriate officer in the county in which the proposed operation is located for posting or publication in accordance with the procedures of that office. No final action shall be taken for a period of 30 days after such posting and mailing.

(b) The notice shall (1) list the time and place of sale the type of sale, bidding method, and the description of the land involved;

(2) contain a request for comments on the fair market value of the tracts being offered for lease sale and the notice shall state the address for submitting comments on fair market values; and

(3) contain information on where a detailed statement of the terms and conditions of any leases which may result from the lease sale may be obtained.

(c) The detailed statement on the terms and conditions of the lease sale offer shall (1) contain an explanation of the manner in which the bids may be submitted;

(2) contain a statement that if sealed bids are submitted they may not be modified or withdrawn unless the modifications or withdrawals are received prior to the time fixed for opening the bids;

(3) contain a warning to all bidders concerning 18 U.S.C. 1860, which prohibits unlawful combination or intimidation or bidders;

(4) specify that the Government reserves the right to reject any and all bids and the right to offer the lease to the next highest qualified bidder if the successful bidder fails to obtain the lease for any reason. If the sale is by oral bid, the statement of terms and conditions of the sale will also specify that sealed bids may be submitted. If any bid is rejected, the deposit will be returned;

(5) contain a request for proof of bidder qualifications and a notice to bidders that the winning bidders will have to submit the information required by the attorney general for his post sale review;

(6) require the payment of one fifth of the bonus bid, if deferred bidding is to be used; and

(7) contain a copy of any written surface owner consents and their terms, or if no consent has been obtained, notice that the tract lease will not be executed until the winning bidder has obtained written surface owner consent.

(d) The successful bidder, if any, shall reimburse the Government for the cost of publishing the notice as a condition of lease issuance.

3422.3 Sale procedures.

3422.3-1 Conduct of sale.

(a) Bids will be received only until the hour on the date specified in the notice of competitive leasing; all bids submitted after that hour shall be rejected. The authorized officer shall read all sealed bids. If the procedure calls for sealed bids followed by oral bids, the oral bidding shall begin at the level of the highest sealed bid. After the oral bidding has ceased, the highest bid shall be announced. No decision to accept or reject the high bid will be made at this time.

(b) A sale panel shall convene to determine if the high bid reflects the fair market value of the tract. The recommendations of the panel shall be sent to the authorized officer who shall make the final decision to accept a bid or reject all bids. The successful bidder shall be notified in writing. The Department reserves the right to reject any and all bids and shall not accept any bid that is less than fair market value. The Department reserves the right to offer a lease to the second high bidder if the successful bidder fails to execute the lease. When the sale is by oral bidding, before bidding is commenced, the authorized officer conducting the sale shall open and read the sealed bids. The successful oral bidder and each sealed bidder shall submit the following with the bid: certified check, cashier's check, bank draft, money order, personal check or cash for one-fifth of the amount of the bid, and a statement over the bidder's own signature with respect to citizenship and interests held, similar to that prescribed in Subpart 3472 of this chapter.

§ 3422.3-2 Other bidding systems.

The use of bidding competition between tracts (intertract bidding) is authorized when and if the Bureau of Land Management and the Geological Survey determine it is needed in the public

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interest. The authorization to use intertract competition does not preclude the use of any other form of competitive bidding procedure.

§ 3422.3-3 Unsurveyed lands.

If the land is unsurveyed, the successful bidder shall not be required to comply with the requirements for lease issuance until the land has been surveyed. See 43 CFR 3471.1-2.

§ 3422.3-4 Consultation with Attorney General

(a) Subsequent to a lease sale, but prior to issuing a lease, the authorized officer shall notify the potential lessee that he must submit the information set out in this subsection relating to his coal holdings to the authorized officer for transmittal to the Attorney General. Upon receipt of the information, the authorized officer shall notify the Attorney General of the proposed lease issuance, the name of proposed lessee; and the terms of the proposed lease. The statement of coal holdings that the authorized officer will transmit shall include the following best available information for each coal tract or deposit controlled by the bidder required by the Attorney General.

(1) location of the tract of deposit (by public land survey subdivisions if applicable);

(2) county and state;

(3) whether Federally or nonFederally owned

(4) interest held by bidder (if Federal, lease or lease application number; if nonFederal, state nature of interest—owner, lessee, operator, joint venturer);

(5) surface ownership;

(6) if the surface is owned by other than bidder, nature of agreement with the surface owner if any;

(7) coal reserves broken down: (A) by tonnage and acreage; and (B) into reserves minable by surface and underground mining methods;

(8) BTU content or rank; and

(9) sulphur content.

(b) Any bidder who has previously submitted the statement of coal holdings may file a statement incorporating the prior statement by reference to the date and lease or application serial number, and containing any and all changes in holdings since the date of the prior submission.

(c) The authorized officer may not issue a lease until 30 days after the Attorney General receives the notice and statement of the bidder's coal holdings. If the Attorney General notifies the authorized officer that the statement of coal holdings is incomplete or inadequate, the 30 day period shall stop running on the date of such notification and not resume running until the Attorney General receives the supplemental information.

(d) The authorized officer shall not issue the lease to the proposed lessee if, during this 30-day period, the Attorney General notifies the authorized officer that issuance of the proposed lease would create or maintain a situation inconsistent with the antitrust laws.

(e) If the Attorney General so notifies the authorized officer that a lease should not be issued, the authorized officer may:

(1) Reject all bids or may notify the Attorney General in accordance with paragraph (a) of this section that issuance of the proposed lease to the next qualified high bidder is under consideration; or

(2) Issue the lease if, after a public hearing is conducted on the record in accordance with the Administrative Procedure Act, the authorized officer determines that: (i) issuance of the lease is necessary to carry out the purposes of the Federal Coal Leasing Amendments Act of 1976; (ii) issuance of the lease is consistent with the public interest; and (iii) there are no reasonable alternatives to the issuance of the lease consistent with the Federal Coal Leasing Amendments Act of 1976, the antitrust laws, and the public interest.

(f) If the Attorney General does not reply in writing to the notification in paragraph (a) of this section within 30 days, the

authorized officer may issue a lease without waiting for the advice of the Attorney General.

§ 3422.4 Award of lease.

(a) Four copies of the lease form shall be sent by certified mail to the successful bidder. These forms shall be completed, signed, and returned within 30 days of receipt. In addition, the bidder shall, within the 30-day period, pay the balance of the bonus bid if required, pay the first year's rental, and file a bond as required by Subpart 3474 of this chapter. Upon receipt of the above the authorized office shall execute the lease.

(b) If the bidder dies before the lease is issued, the provision found in Section 3472.2-4 will apply.

(c) At least half of all competitive coal lease sales shall be held on a deferred bonus payment basis. In a deferred bonus payment, the lessee shall pay the bonus payment in five (5) equal installments: the first installment shall be submitted with the bid. The balance shall be paid in equal annual installments due and payable on the next four anniversary dates of the lease. If a lease is relinquished or otherwise cancelled or terminated, the unpaid remainder of the bid shall be immediately payable to the United States.

Subpart 3425 - Emergency Leasing

3425.0-1 Purpose

This subpart sets forth the procedures for the emergency leasing of Federal coal.

§ 3425.0-2 Objective.

The objective of this subpart is to provide an application process through which the Department of the Interior may consider holding coal lease sales apart from the normal leasing process (Sections 3420.4 through 3420.7) where an urgent need for Federal coal is demonstrated.

§ 3425.0-6 Policy

Leasing proposals developed by this application process differ from those that originate through the normal leasing process only with respect to (a) the method of tract identification and (b) the degree and scope required in the planning and environmental assessment process. This subpart shall be administered so as to maintain the integrity of the normal leasing process.

§ 3425.1 Application - emergency needs.

Application for emergency coal leases covering lands subject to leasing (43 CFR Subpart 3400.2) may be filed with the authorized officer in the Bureau of Land Management State Office having jurisdiction over the lands or minerals involved (43 CFR Subpart 1821).

§ 3425.1-1 Form.

Applications for emergency coal leasing shall be filed on a form approved by the Director, Bureau of Land Management. Three copies of the application and preliminary and other data required by this Subpart shall be submitted with the initial filing.

§ 3425.1-2 Preliminary data.

(a) Any application for a coal lease shall contain preliminary data to assist the authorized officer in making an environmental assessment as described in Section 3430.3-1 of this chapter.

(b) Such preliminary data shall include: (1) a map, or maps, (which may be available from State or Federal sources) showing the topography, physical features and natural drainage patterns, existing roads, vehicular trails, and utility systems; the location of any proposed exploration operations, including seismic lines and drill

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holes; to the extent known, the location of any proposed mining operations and facilities, trenches, access roads or trails, and supporting facilities including the approximate location and extent of the areas to be used for pits, overburden, and tailings; and the location of water sources or other resources that may be used in the proposed operations and facilities.

(2) A narrative statement, including:

(i) the anticipated scope, method, and schedule of exploration operations, including the types of exploration equipment to be used;

(ii) the method of mining anticipated, including the best estimate of the mining sequence and production rate to be followed;

(iii) the relationship between the mining operations anticipated on the lands applied for and existing or planned mining operations, or support facilities on adjacent Federal or non-Federal lands;

(iv) a brief description, including maps or aerial photographs as appropriate, of the existing land-use within and adjacent to the lands applied for; and of known geologic, visual, cultural, or archaeological features; and the known habitat of fish and wildlife, particularly threatened and endangered species, that may be affected by the proposed or anticipated exploration or mining operations and related facilities;

(v) a brief description of the proposed measures to be taken to control or prevent fire and to mitigate or prevent soil erosion, pollution of surface and ground water, damage to fish and wildlife or other natural resources, air and noise pollution, impacts to the social and infrastructure systems of local communities, and hazards to public health and safety; reclaim the surface; and meet other applicable laws and regulations. The applicant may submit other pertinent information that the applicant wishes to have considered by the authorized officer; and

(vi) a statement which describes the intended use of the coal covered by the emergency application.

(c) The applicant shall not undertake any coal mining operations on the land except for casual use, without prior authorization. Casual use, as used in this section, excludes activities that cause significant surface disturbances or damage to lands, resources, and improvements, such as using heavy equipment, explosives, or any off-road vehicle that could disturb the land. Determination of significant surface disturbance or damage shall be made by the authorized officer.

(d) The authorized officer, after reviewing the preliminary data contained in an application, and at any time during an environmental assessment, may request additional information from the applicant.

§ 3425.1-3 Qualifications of the applicant.

(a) Any applicant under this Subpart shall meet the qualifications required of a lessee as specified in Subpart 3472 of this chapter.

(b) In addition, an applicant under this Subpart shall provide data necessary to show that the application conforms to the conditions of acceptance specified in Section 3425.2, and, where the surface of the land is not owned by the Federal Government, documents necessary to show ownership of surface where the surface of the land is held by a qualified surface owner (Section 3400.0-5) and the mining method to be used is other than underground mining techniques. The applicant shall provide a showing that the surface owner consents and provide title evidence to such land surface showing that the consent is conveyed by the legal owner.

§ 3425.1-4 Rejection of applications.

(a) Applications for coal leases shall be rejected in total or in part when (1) it is determined that the application is not consistent with conditions for holding a coal lease sale specified in Section 3425.2; (2) the lands listed in the application are not available for coal leasing under Section 3400.2 of this chapter; (3) some or all the lands applied for are determined to be unsuitable for leasing under provisions of Subpart 3461 of this chapter, or lie within an identified

area of critical environmental concern; (4) the applicant cannot qualify as defined in Section 3425.1-3 to hold a lease under this Subpart; (5) preliminary data required under Section 3425.1-2, including additional information specifically requested in writing by the authorized officer, is found to be insufficient to determine whether the lease proposal meets the conditions for leasing, and to complete required land-use plan or land-use analysis and environmental assessment satisfactorily, (6) where the lease would violate the integrity of the normal leasing process; and (7) it is determined by the authorized officer after thorough investigation of the issues involved that leasing of the lands covered by the application, for environmental or other sufficient reasons, would be contrary to the public interest.

(b) Any applications subject to rejection under paragraph (a)(5) of this section shall not be rejected until the applicant is given written notice of the opportunity to provide requested missing information and fails to do so within the time specified in the decision issued for that purpose.

§ 3425.2 Conditions of acceptance.

(a) A coal lease sale may be held in response to an application under this Subpart only if the applicant can show that:

(1) Either (i) the Federal coal is needed within three years to maintain an existing mining operation at the average annual level of production or new contracted level of production on the date of application, as substantiated by a mining sequence plan and stated proposed production levels; or

(ii) the Federal coal will be bypassed for the reasonably foreseeable future and some portion of the tract of Federal coal will be utilized within three years, as substantiated by a mining sequence plan and stated proposed production levels;

(2) The application involves an existing mining operation that has been producing coal for at least two years before the date of application; and

(3) The need for coal shall have resulted from circumstances that were beyond the control of the applicant or that he could not have reasonably foreseen and planned for.

(b) The Secretary may exempt all or part of an application from paragraph (a)(2) or (3) of this section in a bypass situation (paragraph (a)(1)(ii) of this section) only if he determines in writing that it would be in the public interest.

(c) The tract to be offered for lease shall be as much of the lands applied for as is necessary to meet the emergency need of the applicant without violating the integrity of the normal leasing process.

§ 3425.3 Diligence on emergency leases.

Diligent development or advance royalties shall be required on all emergency leases (See 43 CFR 3400.0-5).

§ 3424.4 Land use plans.

No coal lease shall be issued under this Subpart unless the lands have been included in a comprehensive land use plan or a land use analysis, as required in Section 3420.1-5. All emergency leasing decisions shall be consistent with the appropriate land use plan or analysis.

§ 3425.5 Environmental review.

Before a lease sale may be held in response to an application filed under this Subpart:

(a) the authorized officer shall prepare an environmental assessment of the potential effect of such a coal lease on the area and its environment, including fish and other aquatic resources; wildlife habitats and populations; and visual, recreation, cultural, social and other values in the affected area.

(b) If, based upon the environmental assessment done under subsection (a), the authorized officer determines that an environmental statement is required under the National

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Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), either a statement shall be prepared or the authorized officer may determine that because of critical environmental considerations or limitations in rehabilitation potential, it would not be in the public interest to consider the application in accordance with this Subpart.

(c) For lease applications involving National Forest System lands, the authorized officer shall submit the lease application to the Secretary of Agriculture for consent, for the attachment of appropriate lease stipulations, and for the making of any other findings prerequisite to lease issuance. (43 CFR 3400.3-3).

§ 3425.6 Consultation and sale procedures.

Subsections 3420.5-1 and 3420.5-2 and Subpart 3422 shall apply to all leases offered for sale under the provisions of Subpart 3425.

Subpart 3427 - Split Estate Leasing.

§ 3427.0-1 Purpose.

The purpose of this Subpart is to set out the protection that shall be afforded private surface owners of split estate lands (43 CFR 3400.0-5).

§ 3427.0-3 Authority.

These regulations are issued under the provisions of the authorities cited in 43 CFR 3400.0-3 and in particular, Section 714 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1304).

§ 3427.1 Deposits subject to consent.

All split estate coal deposits for which there are a surface owners (43 CFR 3400.0-5) and that are to be mined by methods other than underground mining techniques shall not be leased without a written consent to enter and commence surface mining operations.

§ 3427.2 Procedures.

(a) Each written consent or evidence of written consent shall be filed with the appropriate State Office of the Bureau of Land Management at least 30 working days prior to the publication of the lease sale notice for the lands to which it applies. It shall be the responsibility of parties intending to file consents to be aware of pending coal lease sale notice dates. Generally, these dates will be as published in the final regional sale schedule (43 CFR 3420.7).

(b) Written consent or evidence of written consent will be accepted from any private person or persons with an interest in promoting the coal lease sale of split estate lands.

(c) A written consent filing shall, at a minimum, contain a true copy of the consent and the present legal address of the surface owner, and the name, ownership, interest, if any, and legal address of the party acquiring consent.

(d) All areas covered by written consents that are filed with the BLM State Office before the final decision on the pending regional lease sale schedule shall be given priority over other split estate areas in the tract identification and ranking processes for that regional lease sale schedule.

(e) Within fifteen working days after receipt of a consent filing, the State Office shall verify that the written consent or evidence of such consent meets all of the following requirements:

(1) The right to enter and commence mining is transferable to whom ever may eventually offer the successful bid on the Federal coal tract for the lands to which the consent applies. A surface owner consent agreement shall be considered transferable only if, at a minimum, it provides that (i) the payment for the consent is to be made by the successful bidder after the lease sale, for the tract to which the consent applies, is held or (ii) after the lease sale, the successful bidder is permitted to reimburse the company which first obtained the consent for the purchase price of the consent.

(2) The named surface owner meets the qualifications set out in Section 3400.0-5 of this chapter and resides at the address specified in the filing.

(3) The title for all lands described in the filing is held by the named surface owners.

(f) Upon receipt of a filing from anyone other than the named surface owner the authorized officer shall contact the named surface owner and request his confirmation in writing that the filed, transferable, written consent to enter and commence mining has been granted and that the filing fully discloses all of the terms of the written consent.

(g) The conditions of (e) and (f) shall be met prior to publication of the sale notice, except that the State Director may determine to publish the notice of lease sale and conduct the sale for coal deposits situated in split-estate lands without consent if it is determined that no tracts comparable to the affected tract can be found to offer in its place and that the successful bidder may be able to negotiate successfully for written consent from the surface owner following the lease sale and before execution of the lease. The State Director may fix a reasonable period of time for such negotiations in the notice of sale. If these negotiations are not successfully concluded within the period of time, the bid shall be rejected and the sale of that tract shall be voided.

The State Director shall in all cases notify the person or persons filing the written surface owner consent or evidence of surface owner consent of the results of the review of the consent filing, including any request for and additional information needed to satisfy the requirements of this Subpart in cases where insufficient information was supplied with the original filing.

(i) The terms of any applicable surface owner consent(s) shall be included with the description of the tract in the notice of lease sale as shall appropriate notice of those tracts that are offered for sale subject to later acquisitions of written consent.

§ 3427.3 Validation of Information.

Person(s) submitting consents shall include with their filing a statement that the evidence submitted in the filing to the best of their knowledge represents a true, accurate, and complete statement of information regarding the surface owner consent for the area described. To qualify to bid at a coal lease sale bidders shall be required to file a statement that all information they hold relevant to surface owner consents affecting any area to be offered in the pending lease sale is on file with the proper State Office of the Bureau of Land Management (43 CFR Subpart 1821).

Persons having knowledge of surface owners who have refused outright to grant written consent are asked to notify the proper Bureau of Land Management State Office (43 CFR Subpart 1821) of such refusals. Should the authorized officer decide on the basis of this information and other evidence that written surface owner consent cannot be obtained for the foreseeable future, tracts that include the consent area shall be assigned lower priority and may be dropped from the ongoing regional ranking and sale scheduling processes.

§ 3427.5 Pre-existing consents.

A written surface owner consent in effect on August 4, 1977 shall be considered valid for the purposes of this Subpart. Where the authorized officer determines that such written consents are not transferable to any potential bidder on the tract in which the area covered by the pre-existing consent is included, he shall offer that tract for sale only in sales using intertract bidding competition as defined in Section 3400.0-5 of this chapter.

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PART 3430 - NONCOMPETITIVE LEASES - COAL

Subpart 3430 - Preference Right Leases

3430.0-1 Purpose.

3430.0-3 Authority.

3430.0-7 Scope.

3430.1 Preference right leases.

3430.1-1 Commercial quantities—standards.

3430.2 Application—required information.

3430.2-1 Additional information.

3430.3 Planning and environment.

3430.3-1 Environmental assessment.

3430.4 Final showing.

3430.4-1 Additional showing.

3430.5 Basis for denial of application.

3430.5-1 Coal lease exchange.

3430.5-2 Appeals, lack of showing.

3430.6 Approval of lease.

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3431.1 Qualified purchaser.

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3435.2 Qualified exchange proponents—limitations.

3435.3 Exchange procedures.

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Subpart 3436 - Coal Lease Exchange—Alluvial Valley Floors

3436.0-1 Purpose.

3436.0-3 Authority.

3436.1 Qualified exchange proponents.

3436.1-1 Limitations.

3436.2 Initiation of exchange.

3436.2-1 Exchange procedures.

3436.3 Financial burden.

3436.4 Issuance of lease.

Subpart 3437 - Fee Coal Exchange—Alluvial Valley Floors

3437.1 Fee coal exchange

AUTHORITY 30 U.S.C. 181 et seq.; 30 U.S.C. 521-531; 30 U.S.C. 351-358; 30 U.S.C. 1201 et seq.; 42 U.S.C. 7101 et seq. and 43 U.S.C. 1701 et seq.

Part 3430 NONCOMPETITIVE LEASES - COAL

Subpart 3430 Preference Right Leases

§ 3430.0-1 Purpose.

These regulations set forth procedures for filing and processing noncompetitive (preference right) coal lease applications on Federal

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coal lands.

§ 3430.0-3 Authority.

These regulations are issued under the authority of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.) and the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351-359).

§ 3430.0-7 Scope.

All lease applications have already been filed by applicants who may be entitled to a noncompetitive lease under the terms of prospecting permits. No additional prospecting permits that confer a preference right to a coal lease shall be issued. Therefore, these regulations address only the procedures for processing pending preference right lease applications.

§ 3430.1 Preference right leases.

An applicant for a preference right lease derived from a prospecting permit for coal shall be entitled to a noncompetitive coal lease if the applicant can demonstrate that commercial quantities of coal were discovered within the term of the permit.

§ 3430.1-1 Commercial quantities—Standards.

(a) The coal deposit discovered under the permit shall be of such character and quantity that a prudent person would be justified in further expenditure of his labor and means with a reasonable prospect of success in developing a valuable mine.

(b) The applicant shall present sufficient evidence to show that there is a reasonable expectation that revenues from the sale of the coal will exceed the cost of developing the mine and extracting, removing, transporting, and marketing the coal. The costs of development shall include the estimated cost of exercising environmental protection measures and rehabilitating disturbed lands.

(c) Standards in paragraphs (a) and (b) shall apply to all applications for preference right coal leases by prospecting permittees.

§ 3430.2 Application - required information for initial showing.

All preference right coal lease applications shall contain the following information:

(a) The measured and indicated quantity of reserves as defined by *Geological Survey Bulletin 1450B* and the quality of the coal reserves.

(1) Quantity shall be indicated by structural maps of the tops of all beds to be mined, isopachous maps of beds to be mined and interburden; and, for beds to be mined by surface mining methods, isopachous maps of the overburden. These maps shall show the location of test holes and outcrops. An estimate of the measured and indicated reserves for each bed to be mined shall be included.

(2) Coal quality data shall include, at a minimum, an average proximate analysis and BTU content of the coal in each seam to be mined. Also, all supporting geological and geophysical data used to develop the required information shall be submitted.

(b) Topographic maps as available from State or Federal sources showing physical features, drainage patterns, roads and vehicle trails, utility systems, and water sources. The location of proposed development and mining operations facilities shall be identified on the maps. These maps shall include the approximate locations and extent of tailings and overburden areas; location and size of pit areas; and the location of water sources or other resources that may be used in the proposed operation and facilities incidental to that use.

(c) A narrative statement that includes:

(1) The anticipated scope of operations, the schedule of operations, and the types of equipment to be used;

(2) The mining method to be used and an estimate of the expected mining sequence and production rate;

(3) The relationship, if any, between operations planned on the land applied for and existing or planned operations and facilities on adjacent lands;

(4) A brief description, including maps or aerial photographs as appropriate of: (i) existing land uses on and adjacent to the applied for land; (ii) known geologic, visual, cultural, or archaeological features; and (iii) known wildlife habitat, particularly that of threatened or endangered species, that may be affected by the planned exploration and mining operations on the applied-for land;

(5) A brief description of measures planned to prevent or control fire and to mitigate or prevent soil erosion, ground and surface water pollution, damage to wildlife or its habitat, air and noise pollution, hazards to public health and safety, and impacts to the social and infrastructural systems of local communities; and

(6) A brief description of any plans that the applicant wishes to have considered by the authorized officer, which show how the applicant plans to reclaim disturbed sites and otherwise meet applicable laws and regulations.

§ 3430.2-1 Additional information.

(a) If the applicant has not submitted all information required in section 3430.2, the authorized officer shall forward a request for additional information and shall specify the information required.

(b) The applicant shall submit certified abstracts indicating the presence of any mining claims lying within or partly within the preference right lease application area that were located prior to the issuance of the prospecting permit.

(c) The applicant shall submit any requested additional information within 60 days of the receipt of the request. The authorized officer may grant one 60-day extension if a written request for extension is received within the first 60-day period.

§ 3430.3 Planning and environment.

A preference right lease may not be issued until the lands involved have been included in an acceptable land use plan or land use analysis that complies with Part 1600 of this chapter or in the absence of such regulations, the governing land use planning requirements applicable to the Bureau of Land Management at the time of lease issuance.

§ 3430.3-1 Environmental assessment.

The authorized officer shall conduct an environmental assessment of the proposed lease area and write an environmental assessment report containing recommendations on lease terms and appropriate stipulations.

(a) The environmental assessment shall include:

(1) an examination of the technical aspects of the proposed operations set forth in any preliminary data and information;

(2) an evaluation of potential impacts of coal leasing and development upon the physical and socioeconomic environment of the proposed lease area and nearby communities;

(3) an evaluation of the technical and natural potential for successful reclamation on the proposed lease area; and

(4) an evaluation of alternatives to leasing the area or to any known plans of operation for the area.

(b) The environmental assessment report shall include recommendations regarding:

(1) lands that should be excluded from the proposed lease area to avoid unacceptable environmental or social impacts;

(2) measures required to avoid, mitigate, or reclaim areas that are acceptable for leasing and development, including lease stipulation recommendations;

(3) an appropriate post-mining land use;

(4) appropriate bonding provisions; and

(5) any additional recommendations applicable to the specific proposed lease area being examined.

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§ 3430.4 Final showing.

(a) Upon completion of the environmental assessment, the authorized officer shall request a final showing by the applicant.

(b) The authorized officer shall transmit to the applicant, with the request for a final showing, the following:

(1) the proposed lease form, including any proposed stipulations that are considered necessary to prevent irreparable damage or destruction of unique environmental values that are identified through the application of the unsuitability criteria in Subpart 3461; and

(2) a copy of the environmental assessment.

(c) Within 60 days of receiving the proposed lease form, the applicant shall submit the following information:

(1) estimated revenues;

(2) the estimated costs that a prudent person would consider before deciding to operate the proposed mine, including but not limited to the cost of developing the mine, removing the coal, processing the coal to make it salable, transporting the coal, paying applicable royalties and taxes, and complying with applicable laws and regulations, the proposed lease terms, and special stipulations;

(3) a comparison of the estimated costs and revenues; and

(4) the estimated cost and revenues of the combined mining venture, if the lease is to become a part of a logical mining unit encompassing adjacent lands.

(d) The information submitted by the applicant shall be sufficiently detailed to determine whether the applicant's showing (1) has a reasonable factual basis, (2) supports the applicant's assertion that the proposed lease contains commercial quantities of coal, and (3) reflects a consideration of all factors required by this section.

§ 3430.4-1 Additional information.

(a) If the applicant for a preference right lease has not submitted all information required in section 3430.4, the authorized officer shall request additional information and shall specify the information required.

(b) The applicant shall submit any requested additional information within 60 days of the receipt of the request. The authorized officer may grant one 60-day extension if a written request is received within the first 60-day period.

§ 3430.5 Basis for denial of application.

The authorized officer shall reject the application if:

(a) The applicant does not respond to a request for additional information within the time period specified in Sections 3430.4-1 or 3430.2-1; or

(b) The final showing of the applicant fails to show that coal exists in commercial quantities on the applied for lands;

§ 3430.5-1 Coal lease exchange.

If the proposed lease has been shown to contain commercial quantities of coal, but the application contains lands that have been determined to be unsuitable for coal development under provisions of the Subpart 3461, the Secretary may initiate the coal lease exchange procedures of Subpart 3435 for the issuance of bidding rights, modifications to an existing coal lease, a mineral lease under 43 CFR Subpart 3526, or in the case of a lease application for lands in an alluvial valley floor, the issuance of a coal lease under 43 CFR Subpart 3436.

§ 3430.5-2 Appeals, lack of showing.

(a) If the application is rejected because the existence of commercial quantities of coal has not been shown, the applicant may, in accordance with the procedures in Part 4 of this title, file a notice of appeal and a statement of the reasons for the appeal.

(b) The applicant shall have the right to a hearing before an Administrative Law Judge if the applicant alleges that the facts in the application sufficiently show entitlement to a lease.

(c) In such a hearing, the applicant shall bear both the burden of going forward and the burden of proof to show, by a preponderance of evidence, that commercial quantities of coal exist in the proposed lease area.

§ 3430.6 Approval of lease.

The lease shall be issued if, upon review of the application, the land use plan or analysis, and environmental assessment record, the authorized officer determines that coal has been discovered in commercial quantities on the lands applied for and that:

(a) Environmental damage can be avoided or acceptably mitigated and the damaged land reclaimed;

(b) The applicant has used reasonable economic assumptions and data to support the showing that coal has been found on the proposed lease in commercial quantities; and

(c) The applicant has considered all factors required by this Subpart.

§ 3430.6-1 Lease terms.

Each lease shall be subject to the requirements for Federal coal leases established in Subpart 3475 of this chapter: diligent development and continued operation, including royalty and rental rates; and logical mining unit requirements except when operations under the lease are interrupted by administrative delays, strikes, natural elements, or casualties not attributable to the lessee as provided in Section 3475.

§ 3430.6-2 Bonding.

The performance and lease bonds shall be set in accordance with Subpart 3474 of this chapter.

§ 3430.6-3 Lease area.

A lease issued under this subpart shall include all lands acceptable for leasing in the final application therefor.

§ 3430.6-4 Duration of leases.

Preference right coal leases shall be issued for a term of 20 years and for so long thereafter as coal is produced in commercial quantities. Each lease shall be subject to readjustment at the end of the first 20-year period and at the end of each period of 10 years thereafter.

§ 3430.6-5 Dating of preference right leases.

Preference right leases shall normally be dated effective the first day of the month following the date signed by the authorized officer. Upon receipt of a prior written request, the lease may be dated effective the first day of the month in which it is signed.

§ 3430.7 Trespass.

Mining operations conducted prior to the effective date of a lease shall constitute an act of trespass and be subject to penalties specified by Section 9239.5 of this chapter.

Subpart 3431 - Negotiated Sales—Right-of-Way

§ 3431.0-1 Purpose.

The purpose of this subpart is to provide procedures for the sale of coal that is necessarily removed in the exercise of a right-of-way issued under Title V of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1761).

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§ 3431.0-3 Authority.

The regulations of this subpart are issued under the authority of section 2(a)(1) of the Mineral Leasing Act of 1920, as amended by section 2 of the Act of October 30, 1978, (30 U.S.C. 201(a)(1)), which authorizes the negotiated sale at fair market value of coal under specified circumstances.

§ 3431.1 Qualified purchaser.

Any person who has acquired a right-of-way under 43 CFR Group 2800 and who must remove Federal coal in order to develop, construct or use the right-of-way is qualified to purchase the coal to be removed.

§ 3431.2 Terms and conditions of sale.

(a) Coal to be removed in connection with a right-of-way shall be sold to the qualified purchaser only at fair market value, as determined by the Secretary.

(b) Where the right-of-way is being used in connection with the development of a Federal coal lease, the removal of coal from the right-of-way shall be subject to the same requirements for health and safety protection, surface protection and rehabilitation, and maximum economic resource recovery that apply to the Federal coal lease(s) involved.

(c) Where the right-of-way is not being used in connection with the development of a Federal coal lease, the removal of the coal shall be made subject to such terms and conditions as the authorized officer determines are necessary to protect public health, safety, and the environment, and to ensure the same maximum resource recovery that is required under a Federal coal lease under the provisions of Group 3400 of this chapter.

(d) All terms and conditions of the sale shall be terms and conditions of the right-of-way and shall be administered under the provisions of Group 2800 of this chapter.

Subpart 3435 - Coal Lease Exchange

§ 3435.0-1 Purpose.

The objective of these regulations is to provide methods for exchange of coal resources when it would be in the public interest to shift the impact of mineral operations from leased lands to currently unleased lands to preserve public resource or social values, and to carry out Congressional directives authorizing coal lease exchanges.

§ 3435.0-3 Authority.

These regulations are issued under the authority of:

(a) Sections 2 and 3 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 201 and 203);

(b) The Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et. seq.); and

(c) Section 310 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1740).

(d) Section 1 of the Act of October 30, 1978 (92 Stat. 2073).

§ 3435.1 Coal lease exchanges.

(1) The relinquishment of a coal lease in exchange for the issuance of a lease for any leaseable mineral other than coal or oil and gas, (2) bidding rights that can be exercised in any subsequent coal lease sale, or (3) Federal coal lease modifications may be appropriate where the Secretary determines that coal exploration development and mining operations would not be in the public interest, or because Congress has authorized lease exchange for a class or list of leases. These interests may be granted to the extent of the Secretary's authority in exchange for the relinquishment of all or part of the Federal coal lease or preference right lease application area that has been or may be determined to be unacceptable for development because of non-coal public values identified or discovered after the

lease or permit was issued, or to facilitate efficient development of coal.

§ 3435.2 Qualified exchange proponents - Limitations.

Any person who holds a preference right lease application and has met the commercial quantities requirements of Section 3430.1-1 for a Federal coal lease or who holds a Federal coal lease on lands described in Section 3435.1, is qualified to ask the Secretary to initiate an exchange.

§ 3435.3 Exchange procedures.

§ 3435.3-1 Exchange notice.

(a) The Secretary may initiate exchange procedures by notifying in writing a Federal mineral lessee or preference right lease applicant that an exchange of mineral leases or other lease interests is considered appropriate.

(b) The exchange notice shall include a statement of why the Secretary believes an exchange is in the public interest.

(c) The notice may contain a description of the lands on which the Secretary would grant lease interests in exchange. The description may include all or part of a lease or preference right application area or more than one.

(d) The notice shall contain a request that the preference right lease applicant or Federal coal lessee indicate whether he is willing to negotiate an exchange.

§ 3435.3-2 Initial response by lessee or lease applicant.

The preference right lease applicant or lessee wishing to negotiate an exchange shall so reply in writing within 60 days of the receipt of the exchange notice. The reply may include a description of the lands on which the lessee or lease applicant would accept an exchange lease or grant of coal lease modifications and, if appropriate, a showing of surface owner consent.

§ 3435.3-3 Agreement to terms.

(a) If both parties wish to proceed with the exchange, the authorized officer and the lessee or preference right lease applicant shall:

(1) Negotiate the selection of appropriate exchange lands containing coal (in those cases where the Secretary is authorized to issue a coal exchange lease) or leaseable minerals other than coal; or

(2) Negotiate appropriate coal lease modifications; or

(3) Establish the value of coal lease bidding rights to be granted in exchange for the relinquishment of the coal lease or preference right; or

(4) Negotiate any combination of the above.

(b) Any land leased in exchange shall, to the satisfaction of the lessee or lease applicant and the Secretary, be a lease tract containing coal or deposits of other leaseable minerals of comparable value to the relinquished deposits. A lease tract is considered comparable for exchange when the Secretary concludes that the leasehold value of the tract to be leased is less valuable than the tract to be relinquished or less than ten percent greater than the tract to be relinquished.

(c) Land proposed for lease in exchange or for inclusion in an existing coal lease shall be subject to leasing under Group 3400 or 3500 of this chapter, as appropriate.

§ 3435.3-4 Determination of value.

The value of the land to be leased in exchange or any bidding rights, or both, shall be equal to the fair market value of the leasehold to be relinquished. A reply to the exchange notice by a preference right lease applicant or lessee indicating willingness to enter into an exchange shall also indicate willingness to provide the geologic and economic data needed by the Secretary to determine the fair market value of the leasehold to be relinquished.

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§ 3435.3-5 Notice and public hearing.

After the lessee or lease applicant and the Secretary agree on the land to be leased, coal lease modifications to be granted, or coal bidding rights to be granted, notice of the proposed exchange shall be published in the FEDERAL REGISTER and in a newspaper of general circulation in the counties or equivalent political subdivisions where both the offered and selected mineral lands are located. The notice shall announce that upon request at least one public hearing will be held in a city located near the tracts involved. The notice shall also contain the Secretary's preliminary findings of why the proposed exchange is in the public interest. The hearing, if any, shall be held to obtain public comments on the merits of the proposed exchange.

3435.3-6 Consultation with Governor(s).

The Secretary will notify the Governor of each state in which lands in the proposed exchange are located of the terms of the exchange and the Secretary's preliminary findings why the exchange is in the public interest. No exchange shall be consummated until at least 45 days after both Governors receive this notification.

§ 3435.4 Issuance of lease or grant of other lease interest.

§ 3435.4-1 Issuance of lease.

(a) If after a public hearing, held if one is requested, the Secretary by written decision concludes that the issuance of an exchange mineral lease or coal lease modification is in the public interest, lease stipulations for operations on the exchange lease or modified lease shall be established.

(b) The exchange lease shall contain:

(1) A statement that the lessee thereby quitclaims any right or interest in the lease or preference right lease application exchanged; and

(2) A statement of the Secretary's findings that lease issuance is in the public interest.

(c) The exchange mineral lease or modified coal lease shall be subject to all relevant provisions of Group 3400 or 3500 of this chapter as appropriate, and 30 CFR Part 211 and 30 CFR Chapter VII Subchapter D.

§ 3435.4-2 Grant of coal lease bidding rights.

(a) If after public hearing, if any is requested, the Secretary by written decision concludes that a grant of bidding rights is in the public interest, a certificate of bidding rights for the value of the relinquished leasehold shall be issued to the proponent.

(b) The certificate of bidding rights shall be useable in whole or in part in any subsequent competitive coal lease sale to pay any part or all of the bonus owed when its holder is the successful bidder at a sale.

Subpart 3436 - Coal Lease Exchange—Alluvial Valley Floors

§ 3436.0-1 Purpose.

The purpose of this Subpart is to establish procedures for coal lease exchanges where coal development operations would interrupt, discontinue, or preclude farming on alluvial valley floors west of the 100th Meridian, west longitude.

§ 3436.0-3 Authority.

These regulations are issued under the authority of section 510(b)(5) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1060).

3436.1 Qualified exchange proponent.

Any person who holds a Federal coal lease west of the 100th Meridian, west longitude, and who has made substantial legal and

financial commitments, as defined in Section 3400.0-5, prior to January 1, 1977 in connection with the lease and otherwise meets the criteria of the proviso in Section 510(b)(5)(30 U.S.C. 1260(b)(5)) may propose an exchange under this subpart.

§ 3436.1-1 Limitations.

The leases offered in exchange by the Secretary must be acceptable for mining operations under criteria of both the Bureau of Land Management and the Office of Surface Mining.

§ 3436.2 Initiation of exchange.

Any lessee who has made substantial financial and legal commitments to a valid lease which includes land on an alluvial valley floor west of the 100th Meridian west longitude may propose the exchange to the Secretary through the Bureau of Land Management office having jurisdiction over the leased land.

§ 3436.2-1 Exchange procedures.

The exchange shall be processed in accordance with the procedures in Subpart 3435 for other lease and lease interest exchanges.

§ 3436.3 Recovery of costs.

The exchange proponent shall bear all administrative costs of the exchange, including the cost of establishing the value of each lease involved in the exchange.

§ 3436.4 Lease issuance.

Any coal lease issued as a result of an exchange under this subpart shall be subject to all relevant provisions of Group 3400 of this chapter, 30 CFR Part 211, and 30 CFR Chapter VII Subchapter D.

Subpart 3427 Fee Coal Exchange

§ 3427 Fee coal exchanges.

Fee coal exchanges qualifying under the criteria of Section 510(b)(5) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1260 (6)(5)) and Section 206 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1716) shall be filed and processed in accordance with the regulations in Subpart 2200 of this chapter.

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PART 3440 - LICENSES TO MINE COAL

Subpart 3440 - Licenses to Mine Coal

3440.0-1 Purpose.

3440.0-3 Authority.

3440.1 Terms.

3440.1-1 Forms.

3440.1-2 Area and duration of license.

AUTHORITY: 30 U.S.C. 181 et seq.

PART 3440 - LICENSE TO MINE COAL

Subpart 3440 - License to Mine Coal

§ 3440.0-1 Purpose.

Coal licenses may be issued without the payment of any rent or royalty for a period of two years to individuals and associations of individuals to mine and take coal for their own local domestic need for fuel. Licenses may be issued to municipalities for the nonprofit mining and disposal of coal to their residents for household use only. Under such a license, a municipality may not mine coal either for its own or for nonhousehold use such as for factories, stores, other business establishments and heating and lighting plants.

§ 3440.0-3 Authority.

Sections 2 to 8, inclusive, of the Act of February 25, 1920, as amended (30 U.S.C. 201, 202-208).

§ 3440.1 Terms.

§ 3440.1-1 Forms.

(a) Four copies of the application for a limited license to mine coal for domestic needs or a renewal for such an existing license shall be filed on a form approved by the Director or a substantial equivalent of the form in the Bureau of Land Management State Office having jurisdiction over the lands involved. The original application or any renewal application shall be accompanied by a fee (43 CFR 3473.2).

(b) No filing fee is required of relief agencies.

(c) A municipality shall file the information required under Section 3472.2-5(b) of this chapter.

§ 3440.1-2 Area and duration of license.

(a) Licenses for an individual or association, in the absence of unusual conditions or necessity, shall be limited to a legal subdivision of 40 acres or less and may be revoked at any time. Such licenses shall expire by limitation at the end of two years from the date of issuance, unless an application for 2 yr. renewal is filed and approved before its expiration date.

(b) The authorized officer may authorize a recognized and established relief agency of any State, upon the agencies request, to take government-owned coal deposits within the State and provide the coal to localities where it is needed to supply families on the rolls of such agency who require coal for household use but are unable to pay for that coal.

(2) Tracts shall be selected in areas determined acceptable for coal leasing and at points convenient to supply the families in a

locality. Each family shall be restricted to the amount of coal actually needed for its use, not to exceed 20 tons annually.

(3) Coal may be taken from such tracts only by those given written authority by the relief agency. All mining shall be done pursuant to such authorization. All Federal and State laws and regulations for the safety of miners, prevention of fires and of waste, etc., shall be observed. The relief agency shall see that the premises are left in a safe condition for future mining operations.

(c) Licenses to municipalities are limited as follows: The area is not to exceed 320 acres for a municipality of less than 100,000 population, not to exceed 1,280 acres for a municipality between 100,000 and 150,000 population, and not to exceed 2,560 acres for a municipality of 150,000 population or more. Licenses to municipalities shall expire by limitation at the end of 4 years from date of issuance, unless an application for a 4 year renewal is filed and approved before its expiration date. Every licensee shall provide an annual report to the Bureau of Land Management describing all operations conducted under such license.

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PART 3450 - MANAGEMENT OF EXISTING COAL LEASES

Subpart 3451 - Continuation of Lease Terms

3451.1 Readjustment of lease terms.

Subpart 3452 - Relinquishments, Cancellations, and Terminations

3452.1 Relinquishments.

3452.1-1 General.

3452.1-2 Where filed.

3452.1-3 Acceptance.

3452.2 Cancellations.

3452.2-1 Judicial proceedings.

3452.3 Termination.

Subpart 3453 - Modifications

3453.1 Application for modification.

3453.2 Availability.

3453.3 Terms and conditions.

Subpart 3454 - Assignments or Transfers and Subleases

3454.1 Qualifications.

3454.1-1 Who may assign or hold an assignment.

3454.1-2 Failure to qualify.

3454.1-3 Number of copies required.

3454.1-4 Sole party in interest.

3454.1-5 Attorney-in-Fact.

3454.1-6 Heirs and devisees.

3454.2 Requirements.

3454.2-1 Forms and statements.

3454.2-2 Filing location and fee.

3454.2-3 Bonds.

3454.2-4 Lease account status.

3454.2-5 Description of lands.

3454.3 Approval.

3454.3-1 Application.

3454.3-2 Effective date.

3454.3-3 Extensions.

AUTHORITY: 30 U.S.C. 181 et seq; 30 U.S.C. 351-359; 30 U.S.C. 521-531; 30 U.S.C. 1201 et seq; 42 U.S.C. 7101 et seq.; and 43 U.S.C. 1701 et seq.;

PART 3450 - MANAGEMENT OF EXISTING COAL LEASES

Subpart 3451 - Continuation of Lease Terms

§ 3451.1 - Readjustment of lease terms

(a) All coal leases issued prior to August 4, 1976, shall be subject to readjustment at the end of the current 20-year period following the issuance of the lease and at the end of the 10-year period thereafter. All coal leases issued after August 4, 1976, shall be subject to readjustment at the end of the first 20-year period and each 10-year period thereafter, if the lease is extended.

(b) The authorized officer shall notify the lessee whether or not any readjustment of terms and conditions will be made. If feasible, notification shall be made before the expiration of the initial 20-year period, or any succeeding 10-year period thereafter.

(c) If the date on which a coal lease became subject to readjustment of terms and conditions occurred before August 4, 1976, but the authorized officer prior to that date neither readjusted the terms and conditions nor informed the lessee that a readjustment would be made, the terms and conditions of that lease shall be readjusted to conform to the requirements of the Federal Coal Leasing Amendments Act of 1976 (90 STAT. 1083).

(d) On any lease subject to readjustment after January 1, 1980, the authorized officer shall notify the lessee whether any readjustment of terms and conditions will be made prior to the expiration of the initial 20-year period or any succeeding 10-year period thereafter. The failure to make timely notification to a lessee shall mean that the United States is waiving its right to readjust the lease for the readjustment period in question.

(e) If the lessee does not file either an objection to the proposed readjustment or a relinquishment of the lease within 60 days after receipt of notice of the proposed readjusted terms from the authorized officer, the terms of such readjustment or relinquishment shall be considered agreed upon and legally binding.

(f) The authorized officer shall require the lessee to furnish information for review by the Attorney General as stated in section 27 of the Mineral Leasing Act of 1920, as amended, (30 U.S.C. 184 (1)). The lease shall be subject to cancellation if the lessee fails to furnish the required information within the time allowed.

Subpart 3452 - Relinquishments, Cancellations and Terminations

§ 3452.1 - Relinquishments.

§ 3452.1-1 General.

Upon a satisfactory showing that the public interest will not be impaired, the lessee may surrender the entire lease or legal subdivision thereof. Partial relinquishment shall describe clearly the surrendered part and give the exact acreage relinquished.

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§ 3452.1-2 Where filed.

A relinquishment shall be filed in triplicate by the lessee in the Bureau of Land Management State Office having jurisdiction over the lands involved (43 CFR Subpart 1821).

§ 3452.1-3 Acceptance.

The relinquishment shall be effective on the date that the authorized officer determines all accrued rentals and royalties have been paid and all requirements on the lessee under the regulations and terms of the lease have been met.

§ 3452.2 Cancellations.

3452.2-1 Judicial proceedings.

(a) The authorized officer after compliance with paragraph (b) of this section, may take the appropriate steps to institute proceedings in a court of competent jurisdiction for the cancellation of the lease if the lessee fails to comply with the provisions of the Mineral Leasing Act of 1920, as amended; with the general regulations in force at the date of the lease, or in force at the effective date of any readjustment of the terms and conditions of the lease under section 3451.1; or with regulations subsequently issued and made applicable under the terms of the lease. The lease shall also be canceled if the lessee defaults in the performance of any of the terms, covenants, and stipulations of the lease. A waiver of any particular cause of forfeiture shall not prevent the cancellation and forfeiture of the lease for any other cause of forfeiture, or for the same cause occurring at any other time.

(b) The lessee shall be given notice of any proposed cancellation and be afforded 30 days to correct the default or to submit evidence showing why the lease should not be cancelled.

(c) Any lease issued or readjusted on or after August 4, 1976, shall be terminated if the lessee does not meet diligent development requirements. Any other lease on which the lessee does not meet diligent development requirements will be subject to cancellation in whole or in part. Any lease on which the lessee does not meet either continued operation or advance royalty requirements shall be subject to cancellation in whole or in part. In deciding whether to initiate lease cancellation proceedings under this subsection, the Secretary shall not consider adverse circumstances which arise out of (1) normally foreseeable costs of compliance with requirements for environmental protection; (2) commonly experienced delays in delivery of supplies or equipment; or (3) inability to obtain sufficient sales.

(d) Existing leases that are not included within an approved mine plan shall be subject to designation of all or part of the lands contained in the lease as unsuitable for surface coal mining as set out in Section 3461.1 (c) of this chapter. This determination shall be made either after an operator submits a mining plan or at the initiation by the leaseholder of a request for exchange. If a lease area or a portion of a lease area is determined to be unsuitable for surface coal mining or the lease is found to be incompatible with the land use plan, the Secretary may enter into negotiations with the lessee for exchange of future bidding rights for coal or other minerals as described in Subpart 3435. If a lease area or portion of a lease area is determined to be unsuitable because of impacts to alluvial valley floors, the Secretary may enter into negotiations with the lessee to exchange the lease for another Federal coal lease in an area acceptable for mining operations pursuant to Subpart 3436 of this chapter.

(e) Should a lease be cancelled or relinquished for any reason, all deferred bonus payments shall be immediately payable and all rentals and royalties, including advance royalties already paid or due, shall be forfeited to the United States.

Subpart 3453 - Modifications.

§ 3453.1 Application for modification.

A lessee may obtain a modification of the lease to include coal lands or coal deposits contiguous to those embraced in that lease if the authorized officer determines that it would be in the interest of the United States to do so. In no event shall the total area added by all modifications made after Aug. 4, 1976 exceed one hundred sixty (160) acres or the same number of acres in the original lease, whichever is less. The lessee shall file the application for modification in the State Office of the Bureau of Land Management having jurisdiction over the lands involved, describing the additional lands desired, the needs and reasons for, and the advantage to the United States of such modification.

§ 3453.2 Availability.

When the authorized officer determines that the modification is justified, that the interests of the United States are served, that there is no competitive interest in the lands or deposits, and that the additional lands or deposits cannot be developed as part of another potential or existing independent operation, the lease will be modified without competitive bidding to include such part of the land or deposits designated by the authorized officer.

§ 3453.3 Terms and conditions.

The terms and conditions of the original lease shall be consistent with the laws, regulations, and lease terms applicable at the time of modification except that the minimum royalty provisions of the Federal Coal Leasing Amendments Act of 1976 shall not apply to any lands covered by the modified lease prior to modification until the term or the original lease or extension thereof which became effective prior to August 14, 1976, has expired. Before a lease is modified, the lessee shall file a written acceptance of the conditions imposed in the modified lease and a written consent of the surety under the bond covering the original lease to the modification of the lease and to extension of the bond to cover the additional land. Such modifications must meet the same environmental safeguards as set out for emergency leases in section 3425.5.

Subpart 3454 - Assignments or Transfers and Subleases

§ 3454.1 Qualifications.

§ 3454.1-1 Who may assign or hold an assignment.

(a) Leases may be transferred in whole or in part to any person, association or corporation qualified to hold such leases, except as provided by Sections 3420.1-4(b)(1)(iii) and 3420.1-4(b)(2)(ii) of this chapter. No transfer shall be approved which would result in violation of the acreage limitations specified in 43 CFR Subsection 3472.1-1.

(b) A minor is not qualified to hold a lease and transfers to a minor shall not be approved. However, an assignment in behalf of a minor heir or devisee of a lessee to a legal guardian or trustee may be approved.

§ 3454.1-2 Failure to qualify.

No transfer shall be approved if the transferee is not qualified under Subpart 3472 of this chapter to take and hold a lease, if the bond is insufficient, if the request was not accompanied by a filing fee or if the transfer would result in the transferee being in violation of the acreage limitations specified in Subpart 3472 of this chapter.

§ 3454.1-3 Number of copies required.

A single signed copy of the qualifications required under Subpart 3472 of this chapter is sufficient.

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§ 3454.1-4 Sole party in interest.

The sole party in interest shall comply with subsection 3472.2-1 of this chapter

§ 3454.1-5 Attorney-in-fact.

The attorney-in-fact shall comply with subsection 3472.2-3 of this chapter

§ 3454.1-6 Heirs and devisees.

Appropriate showing as required under subsection 3472.2-4 of this chapter shall be furnished before the heirs or devisees of a deceased holder of a lease, operating agreement, or royalty interest in a lease can be recognized by the Secretary as the new holder of a lease, agreement, or interest.

§ 3454.3 Requirements.

§ 3454.2-1 Forms and statements.

(a) Assignments or transfers of any record title interest shall be filed in triplicate.

(b) No specific form need be used for assignments, transfers or requests for approval. The application shall contain evidence of the assignee's or transferee's qualifications. This evidence shall consist of the same showing as is required of a lease applicant as set forth in qualifications Subpart 3472 of this chapter.

(c) A separate instrument of assignment or transfer shall be filed for each lease when transfers involve record titles. When transfers to the same person, association, or corporation involving more than one lease are filed at the same time, one request for approval and one showing as to the qualifications of the assignee or transferee will be sufficient.

(d) A single signed copy of all other instruments of transfer is sufficient. Exception: Collateral assignments and other mortgage documents shall not be accepted for filing.

§ 3454.2-2 Filing location and fee.

An application for approval of an assignment or transfer must be filed in the proper Bureau of Land Management Office having jurisdiction over the leased lands proposed for assignment or transfer. Each application shall be accompanied by a nonrefundable filing fee (43 CFR 3473.2).

§ 3454.2-3 Bonds.

(a) If a bond is required it shall be furnished before a lease transfer may be approved. The consent of the surety to the substitution of the transferee as principal or a new bond with the transferee as principal shall be submitted if the original lease required the maintenance of a bond. If the transfer is for part of the leased land only, it shall be for a legal subdivision and (1) the consent of the surety to the transfer and its agreement to remain bound as to the interest retained by the lessee shall be submitted, as well as (2) a new bond with the transferee as principal covering the portion of the leased lands transferred.

(b) The person transferring a lease, including a sublessee, and the surety for the lease shall continue to be responsible for the performance of any obligation under the lease until the effective date of the approval of the transfer. If the transfer is not approved, their obligation to the United States shall continue as though no such transfer had been filed for approval. After the effective date of approval, the transferee, including any sublessee, and the transferee's surety shall be responsible of all lease obligations notwithstanding any terms in the transfer to the contrary.

§3454.2-4 Lease account status.

The lease account shall be in good standing before a transfer may be approved.

§3454.2-5 Description of lands.

The description of the lands involved in the instrument of transfer shall match the description of lands in the lease. The approval of transfer of only a part of the lands described in a lease shall create a new lease.

§3454.3 Approval.

§3454.3-1 Application.

Applications for transfers of leases, whether by direct assignments, working agreements, transfer of royalty interests, subleases or otherwise, shall be filed for approval within 90 days from final execution. Transfers shall include evidence of the qualifications of the transferee, consisting of the same showing required of a lease applicant by Subpart 3472 of this chapter.

§3454.3-2 Effective date.

A transfer shall take effect the first day of the month following its final approval by the Bureau of Land Management, or if the transferee requests, the first day of the month of the approval.

§3454.3-3 Extensions.

The approval of any transfer shall not alter the readjustment periods of the lease.

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PART 3460 - ENVIRONMENT

Subpart 3461 - Federal Lands Review—Unsuitability for Leasing

3461.0-6 Policy.

§ 3465.3-2 Failure of operator to act.

3461.1 Relationship of leasing to unsuitability

§ 3465.4 Alternative postmining land use.

determinations.

§ 3465.5 Bonding.

3461.2 Criteria, unsuitability for surface coal

§ 3465.6 Conducts completion, and abandonment of operations.

mining operations.

§ 3465.7 Failure of operator to act.

3461.3 Exploration.

§ 3465.8 Environmental Statements. Review—Unsuitability for Leasing

3461.4 Designation procedures.

AUTHORITY: 30 U.S.C. 181 et seq.; 30 U.S.C.

3461.4-1 Consultation with local governments.

351-359; 30 U.S.C. 521-531; 30 U.S.C. 1201 et seq.; and 43 U.S.C. 1701 et seq.

3461.4-2 Findings.

3461.4-3 Petitions to designate lands.

3461.4-4 Underground mining exception.

Subpart 3465 - Surface Management and Protection

§ 3465.0-1 Purposes.

§ 3465.0-2 Objective.

§ 3465.0-3 Authorities.

§ 3465.0-7 Applicability.

§ 3465.1 Use of surface.

§ 3465.2 Obligations and standards of performance.

§ 3465.3 Inspections.

§ 3465.3-1 Discovery of noncompliance.

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Subpart 3461 Federal Lands

§3461.0-6 Policy.

(a) The Department will carry out the review of Federal lands under section 522 of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1272) through land use planning determinations by the surface management agency regarding the unsuitability of Federal lands for coal mining.

(b) The Department shall develop sufficient information prior to leasing any tract to be reasonably certain that subsequent operations on any tract can be conducted in compliance with the Surface Mining Control and Reclamation Act of 1977.

(c) All criteria regarding the designation of lands as unsuitable for surface coal mining established by the Office of Surface Mining under 30 CFR §Part 760 shall be used, in addition to the criteria in this subpart, in making unsuitability determinations.

§3461.1 Relationship of leasing to unsuitability determinations.

(a) The unsuitability criteria shall be applied to all lands leased after the issuance of these regulations, including emergency leases and noncompetitive (preference right) leases. The criteria shall be applied directly to the tracts for emergency and noncompetitive lease applications. For all other potential lease tracts, the procedures set forth in 3461.4 shall be followed.

(b) On any area of a tract of Federal coal which has, as a result of the planning activity, been designated unsuitable for certain types of surface coal mining operations, the Secretary shall condition any lease to prohibit those types of surface coal mining operations on the parts of the tract which have been so identified.

(c) For existing leases, the Department may await the lessee's submission of a mining plan before reviewing the acceptability of some or all types of coal development. This shall not preclude evaluation of an existing lease as part of the normal planning process. Unsuitability criteria shall be applied to all non-producing leases. The mine plan shall be reviewed in light of the unsuitability criteria to determine which, if any, apply. If any criterion applies, the specific criterion and any exception to it which applies shall be identified. If a criterion does apply and the conditions do not permit an exception, a further decision shall be made on whether the land is exempt from the criterion because of the source of the authority for the criterion. Mining shall be permitted on land to which no criterion applies; on land where a criterion applies but where the conditions permit an exception; and on land to which a criterion applies, no exception applies, but which is exempt from that criterion.

(d) The criteria in subsections 3461.2(e) through (h), (j), and (n) through (r) shall not apply to lands on which surface coal mining operations were being conducted on August 3, 1977, or where substantial financial and legal commitments to the operations had been made prior to January 4, 1977.

§3461.2 Criteria for designating land unsuitable for all or certain types of coal mining.

(a)(1) All Federal lands included in the following land systems or categories and an appropriate buffer zone, if necessary, as determined by the land management agency, shall be considered unsuitable for coal mining: National Park System, National Wildlife Refuge System, National Systems of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund, Custer National Forest, and Federal lands in incorporated cities, towns, and villages. All Federal lands which are recommended for inclusion in such systems or categories by the Administration in legislative proposals submitted to the Congress or

which are required by statute to be studied for inclusion in such systems or categories shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations may be approved within the Custer National Forest with the consent of the Department of Agriculture as long as no surface coal mining operations are permitted. All designations under this subsection are subject to valid existing rights.

(b)(1) Federal lands that are within rights-of-way or easements or within surface leases for residential, commercial, industrial, or other public purposes, and for agricultural crop production on Federally-owned surface shall be considered unsuitable for coal mining.

(2) *Exceptions:* A lease may be issued, and mining operations approved, in such areas if the land management agency determines that:

(i) All or certain types of coal development (e.g., underground mining) will not interfere with the purpose of the right-of-way or easement; or

(ii) the right-of-way or easement was granted for mining purposes; or

(iii) the right-of-way or easement was issued for a purpose for which it is not being used; or

(iv) the parties involved in the right-of-way or easement agree to leasing; or

(v) it is impractical to exclude such areas due to the location of coal and method of mining and such areas or uses can be protected through appropriate stipulations; or

(vi) with respect to lands on which mining would result in a substantial loss or reduction of long-range productivity of food or fiber products, the operator made substantial financial and legal commitments to the operation prior to January 4, 1977.

(c)(1) Federal lands affected by section 522(e) (3), (4) and (5) of the Surface Mining Control and Reclamation Act (30 U.S.C. 1272 (e)(3),(4), and (5)) shall be considered unsuitable for coal mining. This includes lands within 100 feet of a cemetery, or within 300 feet of an occupied public building, school, church, community or institutional building or public park or within 300 feet of an occupied dwelling.

(2) *Exceptions:* (i) A lease may be issued and mining operations approved for lands used as mine access roads or haulage roads that join the right-of-way for a public road.

(ii) The Office of Surface Mining, Reclamation and Enforcement may issue a permit to have public roads relocated.

(iii) Owners of occupied buildings may give permission to mine within 300 feet of their buildings.

(iv) All designations under this subsection are made subject to valid existing rights.

(d)(1) Federal lands designated as wilderness study areas shall be considered unsuitable for coal mining while under review by the Administration and Congress for possible wilderness designation. For any Federal land which is to be leased or mined prior to completion of the wilderness inventory by the land management agency, the environmental assessment or impact statement on the lease sale or mine plan must consider whether the land possesses the characteristics of a wilderness study area. If the finding is affirmative, the land shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved if authorized by the Wilderness Act (16 U.S.C. 1131 et seq.) and the Federal Land Policy and Management Act of 1976.

(e)(1) Scenic Federal lands designated by visual resource management analysis as Class I or II (an area of outstanding scenic quality or high visual sensitivity) but not currently on the National Register of Natural Landmarks shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved if the land management agency determines that coal mining will not significantly diminish or adversely affect the scenic quality of the designated area.

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(f)(1) Federal lands under permit by the land management agency for scientific studies involving food or fiber production, natural resources or technology demonstrations and experiments shall be considered unsuitable for coal mining.

(2) *Exceptions:* A lease may be issued and mining operations approved:

(i) With the concurrence of the principal scientific user or agency, or

(ii) Where the mining could be done in such a way as not to jeopardize the purpose of the study as determined by the land management agency.

(g)(1) All districts, sites, buildings, structures, and objects of historic, architectural, archeological, or cultural significance which are included in or eligible for inclusion in the National Register of Historic Places, and an appropriate buffer zone around the outside boundary of the designated property (to protect the inherent values of the property that make it eligible for listing in the National Register) as determined by the land management agency, in consultation with the Advisory Council on Historic Preservation or by procedures approved by the Advisory Council, shall be considered unsuitable for coal mining.

(2) *Exceptions:* (i) A lease may be issued and mining operations approved if the land management agency determines:

(A) with the concurrence of the State to which the site, structure, or object is of regional or local significance only; or

(B) in consultation with the Advisory Council on Historic Preservation, the direct and indirect effects of coal mining to a property on or eligible for the National Register of Historic Places will not result in significant adverse impacts to the site, structure, or object.

(ii) All designations under this subsection are made subject to valid existing rights.

(h)(1) Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable for coal mining.

(2) *Exceptions:* A lease may be issued and mining operations approved in these areas or sites if the land management agency determines that:

(i) The area or site is of regional or local significance only, with the concurrence of the State; or

(ii) the use of appropriate mining technology will result in no significant adverse impact to the area or site; or

(iii) the mining of the coal resource under appropriate stipulations will enhance information recovery (e.g., paleontological sites).

(i)(1) Federally designated critical habitat for threatened or endangered plant and animal species, and habitat for Federal threatened or endangered species which is determined by the Fish and Wildlife Service and the land management agency to be of essential value and where the presence of threatened or endangered species has been scientifically documented, shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved if, after consultation with the Fish and Wildlife Service, the land management agency determines the species' habitat will not be adversely affected by all or certain types of coal mining operations.

(j)(1) Lands containing habitat deemed critical or essential for plant or animal species listed by a State pursuant to State law as endangered or threatened shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved if, after consultation with the State, the land management agency determines that the species will not be adversely affected by the coal development.

(k)(1) A bald or golden eagle nest that is determined to be active and a buffer zone of land in a 1/4 mile radius from a nest are areas which shall be considered unsuitable for coal mining. Consideration of availability of habitat for prey species shall be included in the determination of buffer zones.

(2) *Exceptions:* (i) a lease may be issued and mining operations approved if:

(A) they can be conditioned in such a way, either in manner or period of operation, that eagles will not be disturbed during breeding season; and

(B) nest sites will be moved with concurrence of the Fish and Wildlife Service.

(ii) Buffer zones may be decreased if the land management agency determines that the active eagle nests will not be adversely affected.

(l)(1) Bald and golden eagle roost and concentration areas used during migration and wintering shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved if the land management agency determines that mining can be conducted in such a way, and during such periods of time, to ensure that eagles will not be adversely disturbed.

(m)(1) Federal lands containing falcon cliff nesting sites with active nests and a buffer zone of Federal lands 1/4 mile radius from the nest to provide needed prey shall be considered unsuitable for coal mining. Consideration of availability of habitat for prey species shall be included in the determination of buffer zones.

(2) *Exceptions:* (i) A lease may be issued and mining operations approved if: (i) that land management agency determines that coal mining will not adversely impact the nesting sites during the breeding season; or

(ii) nest sites will be moved with concurrence of the Fish and Wildlife Service.

(n)(1) Federal lands which are high priority habitat for migratory bird species of high Federal interest on a regional or national basis, as determined jointly by the Federal land management agency and the Fish and Wildlife Service, shall be considered unsuitable for coal mining.

(2) *Exception:* (i) A lease may be issued where the land management agency, after consultation with the Fish and Wildlife Service, determines that coal mining will not adversely impact the migratory bird habitat during the period when such habitat is used by the species.

(o)(1) Federal lands which the land management agency and the State jointly agree are fish and wildlife habitat for resident species of high interest to the State and which are essential for maintaining these priority wildlife species shall be considered unsuitable for coal mining. Such lands may include appropriate buffer zones as determined jointly by the land management agency and the State. Such lands shall include:

(i) Active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken;

(ii) The most critical winter ranges for deer, antelope and elk; and

(iii) Migration corridors for elk.

(2) *Exceptions:* A lease may be issued and mining operations approved if:

(i) The Federal surface management agency determines that complete mitigation is possible; or

(ii) Following discussions between the State wildlife agency and the Federal land management agency, the Federal land management agency determines that the species being protected will not be adversely affected by the mining activity.

(p)(1) Federal lands containing: (i) inland lakes, impoundments, and associated wetlands;

(ii) inland shallow, predominantly vegetated wetlands; or

(iii) riverine wetland systems, lower and upper perennial systems with flow greater than 5 cubic feet per second and riparian zones in a "relatively undisturbed" state that are larger than one linear mile along a riverine system shall be considered unsuitable for coal mining.

(2) *Exceptions:* A lease may be issued and mining operations approved where the land management agency determines that:

(i) The use of appropriate mining or reclamation technology will not significantly affect the wetlands or will provide for complete restoration; or

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(ii) The wetlands contain no significant values for groundwater recharge, fish and wildlife habitat, recreation or scientific study.

(q)(1) Riverine, coastal, and special floodplains (100-year recurrence interval) shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved where the land management agency determines that:

(i) Leasing a particular tract and approval of mining operations is the only practicable method of access to coal lands acceptable for mining under these criteria, or is consistent with the criteria in Subpart 3425 for emergency leasing; and

(ii) Potential for harm to people or property and natural and beneficial values of floodplains can be minimized through use of demonstrated and available mining and mitigation measures.

(r)(1) Federal lands which have been committed by the land management agency to use as municipal watersheds shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued and mining operations approved where:

(i) The land management agency determines that mining will not adversely affect the watershed to any significant degree; and

(ii) The municipality or water users concur in the issuance of the lease.

(s)(1) Federal lands with National Resource Waters, as identified by states in their water quality management plans, and a buffer zone of Federal lands 1/4 mile from the outer edge of the far banks of the water, shall be unsuitable for coal mining.

(2) *Exception:* The buffer zone may be eliminated or reduced in size where the land management agency determines that it is not necessary to protect the National Resource Waters.

(t)(1) When the land management agency, with the concurrence of the Secretary of Agriculture (Soil Conservation Service), identifies Federal lands having prime farm land soils, such lands shall be considered unsuitable for coal mining.

(2) *Exceptions:* A lease may be issued when:

(i) Conditions such as soil rockiness, angle of slope or historic or other conditions leading to a negative determination under permanent regulations of the Office of Surface Mining Reclamation and Enforcement (OSM) are present; or

(ii) Scientific studies show that crop yields equivalent to pre-mining crop yields on non-mined prime farm lands in the surrounding area under equivalent levels of management could be obtained and that an operator or potential operator could meet the soil reconstruction standards in section 515(b)(7) of the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1265(b)(7)) and Office of Surface Mining Reclamation and Enforcement's permanent regulations.

(u)(1) Federal lands identified by the land management agency, with the concurrence of the State in which they are located, as alluvial valley floors according to the definition and standards of the Surface Mining Control and Reclamation Act of 1977 regulations, final alluvial valley floor guidelines, and approved State programs, where mining would interrupt, discontinue, or preclude farming shall be considered unsuitable for coal mining. Additionally, when mining Federal land outside an alluvial valley floor would materially damage the quantity or quality of water in surface or underground water systems that would supply alluvial valley floors, that land shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued where mining would not interrupt, discontinue, or preclude farming on land to which the first sentence of the criterion applies.

(v)(1) As information regarding reclaimability on a local or regional basis becomes available, the land management agency shall use such information to determine if areas of Federal land are reclaimable to the standards of the Surface Mining Control and Reclamation Act of 1977, the regulations, and approved State programs. Examples of information on reclaimability would be soil studies, hydrologic studies, and studies concerning revegetation. If

any area is determined not to be so reclaimable, such area shall be considered unsuitable for coal mining.

(2) *Exception:* A lease may be issued upon presentation of information which contains results of studies showing that reclamation is possible to the standards of the Surface Mining Control and Reclamation Act of 1977, Office of Surface Mining Reclamation Enforcement's permanent regulations; and approved State programs, including State regulation.

(w)(1) Federal lands in a State to which is applicable a criterion (i) proposed by the State, and (ii) adopted by rulemaking by the Secretary of the Interior, shall be considered unsuitable for coal mining.

(2) *Exceptions:* *f0* A lease may be issued when:

(i) such criterion is adopted by the Secretary less than 12 months prior to the publication of the draft land use plan for the area in which such land is included and

(ii) the land management agency, in consultation with the State, determines that, although the criterion applies, mining will not adversely affect the value which the criterion would protect.

(x)(1) A buffer zone of Federal lands necessary to provide protection for any adjacent area designated as land unsuitable for mining by the State shall be considered unsuitable for coal mining.

(2) *Exception:* *f0* The buffer zone may be modified or eliminated where the land management agency, in consultation with the State, determines that all or parts of the zone are not necessary to protect the designated area.

§ 3461.3 Exploration.

(a) Designation of any area as unsuitable for all or certain types of surface coal mining operations pursuant to sections 522 and 523 of the Surface Mining Control and Reclamation Act (30 U.S.C. 1272, 1273) and the regulations of this Subpart does not prohibit exploration of such area for coal under Subpart 3410 of this chapter.

(b) An application for an exploration license on any lands designated unsuitable for surface coal mining operations shall be reviewed by the Bureau of Land Management to ensure that exploration does not harm any value for which the area has been designated unsuitable for surface coal mining.

§ 3461.4 Designation procedures.

The authorized officer of the Federal land management agency shall describe in the land use plan the results of the application of each of the unsuitability criteria to the planning area. The authorized officer shall state each instance in which a criterion is found to be applicable and show the area which is excluded from leasing, or should the authorized officer determine that the conditions for an exception exist, describe the area to which the exception applies and discuss in detail the reasons why the exception is made and what type of stipulations will be required in the lease or mining permit to assure compliance with the exception.

The authorized officer shall make his recommendation on the best available data that can be obtained given the time and resources available to prepare the plan. The plan shall also disclose when in activity planning, lease sale or post-lease activities the necessary data would be generated. At such time, the authorized officer shall make public his determination on the application of each criterion and the reasons therefor. The description in the plan should explain whether additional data would be likely to significantly affect the conclusions reached about unsuitability.

All lands not designated unsuitable for surface mining may be considered further in the land use planning process. All lands designated unsuitable for surface mining may be considered in this process with the condition that only underground mining would be allowed consistent with the general exception.

After a land use plan is completed, the Department may exclude additional lands from leasing for surface mining as warranted by new information without formally revising the plan. A description of any

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lands so excluded shall be added to the documentation developed during the tract identification phase of activity planning (43 CFR 3420.4).

§3461.4-1 Consultation with local governments.

Prior to designating Federal lands unsuitable for all or certain types of surface mining operations, the Secretary shall consult with the appropriate State and local agencies (43 CFR 3420.2-5).

§3461.4-2 Findings.

Prior to designating Federal lands unsuitable, the Secretary shall prepare a detailed statement on (i) the potential coal resources, (ii) the demand for coal resources, and (iii) the impact of such designation on the environment, the economy, and the supply of coal.

§3461.4-3 Petitions to designate lands.

Petitions for designation or termination of a designation of Federal lands as unsuitable for surface coal mining operations shall be processed by the Office of Surface Mining Reclamation and Enforcement under 30 CFR Part 769.

§3461.4-4 Underground mining exception.

Federal lands with coal that will be mined by underground mining methods shall not be considered unsuitable for coal mining where the mining will result in no surface effects. Where underground mining will produce surface effects on Federal lands to which a criterion applies, it shall be considered unsuitable unless the surface managing agency finds that a relevant exception applies. Surface effects include surface occupancy, subsidence, fire, and other environmental impacts of underground mining which are manifested on the surface.

Subpart 3465 - Surface Management and Protection.

§ 3465.0-1 Purpose.

This Subpart establishes rules for the management and protection of the surface of the Federal coal lands when coal resources are developed.

§ 3465.0-2 Objective.

This subpart is designed to ensure effective and reasonable coal mining operations, and reclamation of mined lands in a manner that will minimize any adverse social, economic, and environmental effects of the coal mining operations.

§ 3465.0-3 Authorities.

See subsection 3400.0-3.

§ 3465.0-7 Applicability.

(a) This subpart applies to leases, and licenses under 30 U.S.C. 208, issued by the Bureau of Land Management for the development of Federal coal.

§ 3465.1 Use of surface.

(a) The operator shall use only that part of the surface area included in his lease or license that has been included in an approved permit (30 CFR Part 741).

(b) Separate leases, permits or rights-of-way under appropriate provisions in Title 43 of the Code of Federal Regulations are required for the installation of power generation plants or commercial or industrial facilities on the leased lands; or for the use of mineral materials or timber from the lease lands.

(c) Other land uses under other authorities may be authorized on an area leased or licensed for coal development provided there is no

unreasonable conflict and that neither operation is endangered by the presence of the other.

§ 3465.2 Obligations and standards of performance.

(a) An operator of a coal lease or license shall comply with the regulations in this subpart and with the terms and conditions of the lease or license.

(b) An operator shall comply with the applicable performance standards in 30 CFR Chapter VII, Subchapter D.

(c) When changed conditions or newly discovered information indicate that an approved permit (30 CFR 741) needs to be reviewed or supplemented, the authorized officer may propose the appropriate revision or supplement to the Office of Surface Mining Reclamation and Enforcement.

(d) The authorized officer may develop and include additional specific stipulations in any license involving special management consideration.

§ 3465.3 Inspections.

The authorized officer, Mining Supervisor, or inspectors from the Office of Surface Mining Reclamation and Enforcement shall have the right to enter lands under a Federal coal lease or license at any reasonable time.

§ 3465.3-1 Discovery of noncompliance.

(a) Upon discovery of activities that are not in compliance with lease or license terms or with an approved permit (30 CFR 741), but that do not pose a serious and immediate threat to public health and safety or to resources and environmental quality, the authorized officer shall refer the matter to the Office of Surface Mining Reclamation and Enforcement for remedial action, or to the Mining Supervisor on matters of exploration.

(b) Upon discovery of activities that are not in compliance with lease or license terms or an approved permit and that do pose a serious and immediate threat to public health and safety or to resources and environmental quality, the authorized officer may order the immediate cessation of the threatening activities, provided that the Office of Surface Mining Reclamation and Enforcement is immediately informed of any emergency cessation order issued.

§ 3465.3-2 Failure of operator to act.

Failure of an operator to comply with an emergency cessation order issued under section 3465.3-1(b) or with a written notice of noncompliance issued by the Office of Surface Mining Reclamation and Enforcement in accordance with 30 CFR Part 211 or 30 CFR Chapter VII, Subchapter D shall be grounds for suspension of the operator's permit and may be grounds for cancellation of the lease or license, in accordance with Subpart 3452 of this chapter.

§ 3465.4 Alternative postmining land use.

When an applicant or operator proposes any postmining land use that is substantially different from the land use prior to exploration and mining, the Office of Surface Mining Reclamation and Enforcement with the approval of the authorized officers of the appropriate surface management agencies, may approve such alternative postmining land use. The authorized officer shall not approve the alternative postmining land use unless it:

(a) does not conflict with land use plans for the lease or license area and surrounding lands;

(2) is considered an equal or better economic or public use of the land as compared to the premining use of the land;

(3) does not, as determined by the authorized officer, cause a significant adverse impact upon the aesthetic character of the land or the lives of people who inhabit the area immediately surrounding the leased or licensed land; and

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(4) is approved by the legal owner of the surface where the surface is privately owned.

§ 3465.5 Bonding.

(a) Bonding regarding compliance with coal lease or license terms shall be furnished in accordance with the applicable provisions of Subpart 3474 of this chapter.

(b) A reclamation bond shall be secured in accordance with 30 CFR Part 742.

(c) An application for a lease or license may be denied any applicant who has previously forfeited a bond because of failure to comply with an approved plan (30 CFR Part 741) or permit unless the affected lands covered by that plan or permit have been reclaimed without cost to the Federal Government. Nothing in this section shall modify or limit the discretionary authority of the authorized officer to deny for other cause any application for a lease or license.

§ 3465.6 Conduct, completion, and abandonment of operations.

All terms of the operations permit shall be administered under 30 CFR Chapter VII, Subchapter D and 30 CFR Part 211.

§ 3465.7 Failure of operator to act.

Failure of an operator to comply with an emergency cessation order issued under Section 3465.5-1(b) or with a written notice of noncompliance issued by the Office of Surface Mining Reclamation and Enforcement in accordance with 30 CFR 211 or 30 CFR Subchapter D shall be grounds for suspension of the operator's permit and may be grounds for cancellation of the lease or license, in accordance with Subpart 3452 of this chapter.

§ 3465.8 Environment statements.

If the Director of the Office of Surface Mining Reclamation and Enforcement determines that a decision to approve any alternative postmining land use or alternative rehabilitation practices would constitute a major Federal action requiring an environmental statement under section 102(2)(C) of the National Environmental Policy Act (42 U.S.C. 4332 (2)(c)) and that the decision has not been discussed in any environmental statement that may have been prepared for the approval of a permit, a statement shall be prepared by the Director of the Office of Surface Mining Reclamation and Enforcement.

PART 3470 - COAL MANAGEMENT PROVISIONS AND LIMITATIONS

Subpart 3471 - Coal Management Provisions and Limitations

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AUTHORITY; 30 U.S.C. 181 et seq. and 30 U.S.C. 351-359

Subpart 3471 - Coal Management Provisions and Limitations

§3471.1 Land description requirements.

§3471.1-1 Land description in application.

(a) Any application for a Federal coal lease, modification or license shall include a complete and accurate description of the lands for which the lease or license is desired.

(1) If the lands have been surveyed under the public land rectangular system, each application shall describe the lands by legal subdivision (section, township, and range), or aliquot part thereof (but not less than 10 acres).

(2) Where protraction surveys have been approved and the effective date has been published in the FEDERAL REGISTER, applications to lease lands shown on such protraction surveys and filed on or after the effective date shall contain a description of the lands according to the section, township, and range shown on the approved protraction surveys.

(3)(a) If the lands have not been surveyed on the ground and are not shown on the records as protraction surveys, applications shall describe the lands by metes and bounds, giving courses and distances between the successive angle points on the boundary of the tract, in cardinal directions except where the boundaries of the lands are in irregular form, and connected by courses and distances to an official

corner of the public land surveys. In Alaska, the description of unsurveyed lands shall be connected by courses and distances to either an official corner of the public land surveys or to a triangulation station established by an agency of the United States such as the U.S. Geological Survey, the Coast and Geodetic Survey, or the International Boundary Commission, if the record position is available to the general public. For areas covered by skeleton township surveys (Section 3471.2-1).

(b) If the lands are acquired lands which have not been surveyed under the rectangular system of public land surveys, and the tract is not within the area of the public land surveys, the lands shall be described as in the deed or other document by which the United States acquired title to the lands or minerals.

(1) If the desired land constitutes less than the entire tract acquired by the United States, it shall be described by courses and distances between successive angle points on its boundary tying by course and distance into the description in the deed or other document by which the United States acquired title to the land.

(2) In addition, if the description in the deed or other document by which the United States acquired title to the land does not include the courses and distance between the successive angle points on the boundary of the desired tract, the description in the application shall be expanded to include such courses and distances.

(3) Applications shall be accompanied by a map on which the desired lands are clearly marked showing their location with respect to the administrative unit or project of which they are a part. It is not necessary to submit a map if the desired lands have been surveyed under the rectangular system of public land surveys, and the land description can be conformed to that system.

(4) If an acquisition tract number has been assigned by the acquiring agency to the identical tract desired, a description by tract number will be accepted in the offer or application.

(5) Any accreted lands desired, but not described in the deed to the United States, shall be described by metes and bounds, giving courses and distances between the successive angle points on the boundary of the tract, and connected by courses and distances to an angle point on the perimeter of the acquired tract to which the accretions belong.

§3471.1-2 Land description in lease.

All lands proposed for leasing in a public land survey system State shall have a cadastral survey performed at Federal Government expense before a lease may be issued except in areas covered by a skeleton survey, i.e. Utah and Alaska, and the lease when issued shall be described by legal subdivision, (section, township, and range) or aliquot part thereof (but no less than 10 acres).

§3471.2 Effect of transactions.

§3471.2-1 Land disposal with a reservation of minerals.

(a) Where the lands included in a lease or license have been or may be disposed of with reservation of the coal deposits, a lessee or licensee must make full compliance with the law under which the reservation was made. See the Acts of March 3, 1909 (35 Stat. 844; 30 U.S.C. 81); June 22, 1910 (36 Stat. 583; 30 U.S.C. 83-85); December 29, 1916 as amended (39 Stat. 862; 43 U.S.C. 291-301); June 17, 1949 (63 Stat. 200); June 21, 1949 (63 Stat. 215; 30 U.S.C. 54); March 8, 1922 (42 Stat. 415; 48 U.S.C. 376-377); October 21, 1976 (90 Stat. 2759; 43 U.S.C. 1719), and other laws authorizing such reservation.

(b) Any sale or conveyance of lands subject to the Mineral Leasing Act for Acquired Lands by the agency having jurisdiction, shall be subject to any lease or license previously issued under that act.

(c) Leases on acquired lands outstanding on August 7, 1947, and covering lands subject to the Mineral Leasing Act for Acquired Lands may be exchanged for new leases to be issued under the Act, subject in each case to such appropriate conditions as may be prescribed.

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(d) When the coal is to be mined by other than underground mining techniques, the surface of the land is owned by a surface owner, and the lease is issued after August 3, 1977, the lessee shall comply with the terms of the valid written consent of the surface owner when consistent with Federal and State reclamation laws and regulations (43 CFR 3420.6).

3471.2-2 Effect of conveyance to State or local entities.

If the United States has conveyed the title to, or otherwise transferred control of the land surface containing the coal deposits to any State or political subdivision, agency, or its instrumentality, to a college, any other educational corporation, or association, or to a charitable or religious corporation or association, the party shall be notified by certified mail of the application for the license or lease. The agency shall be given a reasonable period of time within which to suggest any stipulations necessary for the protection of existing surface improvements or uses to be included in the license or lease and state the supporting facts, or to file any objections to its issuance and state the supporting facts. (If this party opposes the issuance of the license or lease, the facts submitted in support of the opposition must be carefully considered and each case separately decided on its merits.) However, opposition is not a bar to issuance of the license or lease for the reserved minerals in the lands. In each case, the final determination on whether to issue the license or lease is based on the best interests of the public.

3471.3 Cancellation or forfeiture.

3471.3-1 Cancellation or forfeiture for cause

Any Federal coal lease or license may be cancelled or forfeited for violation of the Act under which the lease or license was issued, violation of applicable Federal regulations, or violation of the terms of the lease or license (43 CFR 3452.2).

3471.3-2 Protection of bona fide purchaser.

(a) Cancellation or forfeiture for violation of provisions of the Mineral Leasing Act of 1920, as amended, or the Mineral Leasing Act for Acquired Lands, shall not be applied if it adversely affects the title or interest of a bona fide purchaser of any lease, or the option to acquire a license, lease, interest, or option, that was acquired and is held by a qualified person, association, or corporation in conformity with those provisions, even though the holdings of the person, association, or corporation from which the lease, interest, option, or license was acquired, or of his predecessor in title (including the original lessees of the United States) may have been cancelled or forfeited or may be or may have been subject to cancellation or forfeiture for any such violation, save that the purchaser shall have a period to be determined by the authorized officer and not to exceed 180 days to correct the cause of cancellation or forfeiture.

(b) Any party to any proceedings with respect to a violation of any provision of the mineral leasing acts referred to in paragraph (a) of this section has the right to be dismissed promptly as a party by showing that he or she holds and acquired his or her interest as a bona fide purchaser without having violated any provisions of the mineral leasing acts, referred to in paragraph (a) of this section. No hearing shall be necessary on such showing unless prima facie evidence is presented to indicate a possible violation on the part of the alleged bona fide purchaser.

(c) If during any such proceeding a party waives his or her rights under the lease, or if such rights are suspended by order of the Secretary pending a decision, rental payments and time counted against the term of the lease shall be suspended as of the first day of the month following the filing of the waiver or the Secretary's suspension until the first day of the month following the final decision in the proceeding or the revocation of the waiver or suspension.

§ 3471.3-3 Sale of underlying interests.

If in any proceeding to cancel or forfeit a lease, interest in a lease, option to acquire a lease (or an interest in the option), or a license acquired in violation of any of the provisions of the Act, the lease, interest, option, or license is cancelled or forfeited to the Government, and if there are valid options to acquire the lease or an interest in one that are not subject to cancellation, forfeiture, or compulsory disposition, this lease, interest, option, or license shall be sold to the highest responsible qualified bidder by competitive bidding, in a manner similar to that provided for in the offering of leases by competitive bidding subject to all outstanding valid interests therein and valid options pertaining thereto. If less than the whole interest in the lease, interest, option, or permit is cancelled or forfeited, the partial interest shall be sold in the same way. If no satisfactory offer is obtained as a result of the competitive offering of a whole or partial interest, it may be sold by other methods that the authorized officer finds appropriate. However, the terms must not be less favorable to the Government than those of the best competitive bid received.

§3471.4 Future interest, acquired lands.

An application to lease future interests filed less than one year prior to the date of the vesting in the United States of the present interest in the coal will be rejected. Upon the vesting in the United States of the present possessory interest in the coal, all applications for future interest leases outstanding at the time will automatically lapse. Only offers for a present interest lease will be considered after that time.

Subpart 3472 - Qualification Requirements

§ 3472.1 Qualified applicants and bidders.

A coal license or lease may be issued only to (a) citizens of the United States; (b) associations of citizens organized under the laws of the United States or of any States that are authorized to hold such interests by State statute and by the instrument establishing the association; (c) corporations organized under the laws of the United States or of any State, including a company or corporation operating a common-carrier railroad; and (d) public bodies, including municipalities.

§ 3472.1-1 Special qualification provisions.

(a) Each applicant or bidder for a lease shall furnish a signed statement showing that with the area applied for, the applicant's interest(s) in Federal leases and applications, directly or indirectly, do not exceed in the aggregate the acreage limitation in Section 3472.1-2.

(b) A coal lease or license shall not be issued to a minor but leases or licenses may be issued to a legal guardian or trustee on behalf of a minor.

(c) Every company or corporation operating a common-carrier railroad shall make a statement that it needs the coal for which it seeks a license or lease solely for use on its own railroad; that it operates main or branch lines in the State in which the lands involved are located; that the aggregate acreage in the licenses, leases, and applications in which it holds interest directly or indirectly does not exceed 10,240 acres; and that it does not hold more than one license or lease for each 200 miles of its railroad lines served or to be served from such coal deposits. This last requirement excludes spurs or switches, branch lines built to connect the leased coal with the railroad, and parts of the railroad operated mainly by power not produced by steam.

(d) Aliens may not acquire or hold any direct or indirect interest in licenses or leases, except that they may own or control stock in corporations holding license or leases if the laws of their country do not deny similar or like privileges to citizens of the United States.

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If any appreciable percentage of stock of a corporation is held by aliens who are citizens of a country denying similar or like privileges to United States citizens, its application or bid for a lease shall be denied.

§ 3472.1-2 Maximum acreage limitation.

(a) (1) No person, association, or corporation, or any subsidiary, affiliate, or persons controlled by or under common control with such person, association, or corporation shall take, hold, own or control at one time Federal coal leases or applications on more than 46,080 acres in any one State, and in no case on more than 100,000 acres in the United States.

(2) No person, association, or corporation holding, owning, or controlling Federal coal leases including preference right lease applications (individually or through any subsidiary, affiliate, or person under common control) on more than 100,000 acres in the United States on August 4, 1976, shall be required to relinquish any lease or applications held on that date. However, it shall not be permitted to have any additional interests in any further Federal coal leases or applications until such time as its holding, ownership, or control of Federal leases or applications has been reduced below 100,000 acres within the United States.

(b)(1) In computing acreage holdings or control, the accountable acreage of a party owning an undivided interest in a lease shall be the party's proportionate part of the total lease acreage. Similarly, the accountable acreage of a party owning an interest in a corporation or association shall be the party's proportionate part of the corporation's or association's accountable acreage. However, no person shall be charged that person's pro rata share of any acreage holdings of any association or corporation, unless that person is the beneficial owner of more than 10 percent of the stock or other instruments of ownership or control of such association or corporation.

(2) On acquired lands, if the United States owns only a fractional interest in the coal resources of the lands involved, only that part of the total acreage involved in the lease, proportionate to the extent of ownership by the United States of the coal resources, shall be charged as acreage holdings. The acreage embraced in a future interest lease is not to be charged as acreage holdings until the lease for the future interest takes effect.

§ 3472.2 Filing of qualification statements.

Each applicant or bidder for a Federal coal lease or license shall file a statement of his qualifications to hold the lease or license. The statement shall be filed with the application or bid. The statement shall be filed with the application or bid in the Bureau of Land Management State Office having jurisdiction over the lands (43 CFR Subpart 1821).

§ 3472.2-1 Sole Party in interest statement.

Every applicant or bidder for a lease or license shall submit at the time of filing a signed statement that the applicant is the sole party in interest in the application or bid, and the lease or license, if issued; if not, the applicant shall set forth the names of the other interested parties in the application or bid, a separate or joint statement shall be signed by them and by the applicant or bidder setting forth the nature and extent of the interest of each in the application or bid, the nature of the agreement between them, if oral, and a copy of such agreement if written. Such separate or joint statement of interest and written agreement, if any, or a statement of the nature of such agreement, if oral, shall accompany the application or bid. All interested parties shall furnish evidence of their qualifications to hold such interest in the lease or license, including a statement regarding knowledge of surface owner consents for the area involved (43 CFR Part 3427).

§ 3472.2-2 Contents of qualification statement.

(a) If the applicant or bidder is an individual, a signed statement setting forth the applicant's citizenship shall be submitted with each application or bid for a license or lease.

(b) If the applicant or bidder is an association or partnership, the application shall be accompanied by a certified copy of its articles of association or partnership, together with a statement showing (1) that it is authorized to hold leases; (2) that the member or partner executing the lease is authorized to act on behalf of the association or partnership in such matters; (3) the names and addresses of all members owning or controlling more than 10 percent of the association or partnership and their citizenship and holdings; and (4) if any member of the partnership or association is a corporation, the information required in subsection (c) for each member corporation. Applicants who have previously filed qualification statements may submit either a serial number reference to the record and office where the statement is filed or a new qualification statement.

(c) If the applicant or bidder for a lease or license is a corporation, it must submit statements showing (1) the State of incorporation; (2) that it is authorized to hold coal leases or licenses; (3) names of the officers authorized to act on behalf of the corporation; (4) the percentage of the corporation voting stock and all of the stock owned by aliens or those having addresses outside of the United States; and (5) the name, addresses, citizenship, and acreage holdings of any stockholder owning or controlling 10 percent or more of the corporate stock of any class. If more than 10 percent of the stock is owned or controlled by or on behalf of aliens, or persons who have addresses outside of the United States, the corporation shall provide their names and addresses, the amount and class of stock held by each, and to the extent known to the corporation or which can be reasonably ascertained by it, the facts as to the citizenship of each. Applicants who have previously filed qualification statements may submit either a serial number reference to the record and office where the statement is filed or a new qualification statement. Applications on behalf of a corporation must be accompanied by proof of the signing officer's authority to execute the instrument except in a case where an officer of a corporation signs an application on behalf of the corporation.

(d) To qualify as a public body for the purpose of bidding on any Tracts to be offered as part of a special opportunity lease sale for public bodies, the applicant must submit the information required in Subpart 3472.2-5.

(e) To qualify as a small business for the purpose of bidding on any tracts to be offered as part of a special opportunity lease sale for small businesses, the applicant must submit evidence demonstrating qualification under 13 CFR 121.

(f) Where there is a legal guardian or trustee, the following shall be provided: a certified copy of the court order authorizing the guardian or trustee to act as such and to fulfill in behalf of the minor or minors all obligations of the lease or arising thereunder; statements by the guardian or trustee as to the citizenship and holdings of each of the minors and as to the trustee's own citizenship and holdings, including holdings for the benefit of other minors.

§ 3472.2-3 Signature of applicant.

All applications or bids shall be signed by the applicant or bidder, or by their attorney-in-fact. If executed by an attorney-in-fact, the application or bid shall be accompanied by the power of attorney and the applicant's own statement as to citizenship and acreage holdings unless the power of attorney specifically authorizes and empowers the attorney-in-fact to make such statements or to execute all statements which may be required under these regulations.

§ 3472.2-4 Special provisions, heirs and devisees (estates).

If an applicant for a license, an applicant for a preference right lease, or a successful bidder for a competitive lease dies before the license or lease is issued, the license or lease will be issued to the

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executor or administrator of the estate if the estate has not been probated; if probate has been completed, or is not required, to the heirs or devisees; and if there are minor heirs or devisees, to their legal guardian or trustee in the bidder's name, provided the following information has been filed:

(a) Where probate of the estate has not been completed: (1) evidence that the person who, as executor or administrator submits forms of lease and bond, has authority to act in that capacity and to sign such forms; (2) evidence that the heirs or devisees are the heirs or devisees of the deceased permittee, licensee, lessee, or successful bidder, and are the only heirs or devisees of the deceased; and (3) a statement over the signature of each heir or devisee concerning citizenship and holdings.

(b) Where the executor or administrator has been discharged or no probate proceedings are required, the following shall be filed: (1) a certified copy of the will or decree of distribution, if any, and if not, a statement signed by the heirs that they are the only heirs of the licensee, lessee, or successful bidder, and citing the provisions of the law of the deceased's last domicile showing that no probate is required; and (2) a statement over the signature of each of the heirs or devisees with reference to citizenship and holdings, except that, if the heir or devisee is a minor, the statement shall be over the signature of the guardian or trustee.

§ 3472.2-5 Special provisions, public bodies.

(a) To obtain a lease on a tract set aside pursuant to 30 U.S.C. 201(a) a public body shall submit:

- (1) Evidence of the manner in which it is organized;
- (2) Evidence that it is authorized to hold a lease;
- (3) Evidence that the action proposed has been duly authorized by its governing body; and
- (4) A definite plan to produce energy within the next 10 years solely for its own use or for sale to its members or customers (except for short-term sales to others).

(b) To obtain a license to mine coal pursuant to 30 U.S.C. 208, a municipality shall submit:

- (1) Evidence of the manner in which it is organized;
- (2) Evidence that it is authorized to hold a license; and
- (3) Evidence that the action proposed has been duly authorized by its governing body.

(c) To obtain a lease pursuant to 30 U.S.C. 352 on a tract of acquired lands set apart for military or naval purposes, a governmental entity shall submit:

- (1) Evidence of the manner in which it is organized, including the State in which it is located;
- (2) Evidence that it is authorized to hold a lease;
- (3) Evidence that the action proposed has been duly authorized by its own governing body; and
- (4) Evidence that it is producing electricity for sale to the public in the State where the lands to be leased are located.

(d) If the material required in paragraphs (a), (b), and (c) of this section has previously been filed, a reference to the serial number of the record in which it has been filed, together with a statement as to any amendments, shall be accepted.

Subpart 3473 - Fees, Rentals, and Royalties

§3473.1 Payments.

§3473.1-1 Form of remittance.

Remittances shall be submitted as cash, money order, check, certified check, bank draft or bank cashier's check.

§3473.1-2 Where remitted.

(a) Unless otherwise directed by the Secretary, rentals for all coal leases issued shall be paid to the Bureau of Land Management State

Office having jurisdiction over the leased lands (43 CFR Subpart 1821). All remittances shall be made payable to the Bureau of Land Management.

(b) Rentals and royalties on producing coal leases shall be paid to the Mining Supervisor for the area in which the lands under lease are situated. All remittances shall be made payable to the U.S. Geological Survey.

§3473.1-3 When remitted.

First year rental for preference right leases shall be remitted at the time of filing applications. First year rental for competitive leases shall be payable when required by decision. Thereafter, rental for all leases shall be paid in accordance with the lease provisions.

§3473.2 Fees.

§ 3473.2-1 General fee provisions.

A filing fee of \$250.00 must accompany each application for an emergency lease, exploration license, and lease modification. A filing fee of \$50.00 must accompany each application for approval of assignment, or approval of any instrument transferring a lease or interest therein. The fee shall be retained as a service charge even if an application is rejected or withdrawn in whole or in part. An application not accompanied by the filing fee shall be rejected by the authorized officer.

§3473.2-2 Exemptions from fee provisions.

No filing fee is required for:

- (a) Coal licenses to relief agencies as described in Subpart 3440 of this chapter; or
- (b) Preference right lease applications.

§3473.3 Rentals and royalties.

§3473.3-1 Rentals.

Annual rental per acre or fraction thereof shall not be less than \$3. The amount of the rental will be specified in the lease.

(a) On leases issued before August 4, 1976, the rental paid for any year shall be credited against the royalties for that year until the lease is readjusted.

(b) On leases issued or readjusted after August 4, 1976, rental payments may not be credited against royalties.

§3473.3-2 Royalties.

(a) Royalty rates shall be determined on an individual case basis prior to lease issuance. Such rates shall be set out in the notice of competitive lease sale.

(1) A coal lease shall require payment of a royalty of not less than 12-1/2 percent of the value of the coal removed from a surface mine.

(2) A coal lease shall require payment of royalty of not less than 8 percent of the value of the coal removed from an underground mine, except that the authorized officer may determine a lesser amount if conditions warrant.

(3) The value of coal removed from a mine is defined for royalty purposes in 30 CFR 211.63.

(b) The Mining Supervisor shall have discretion, upon the request of the lessee, to authorize the payment of an advance royalty in lieu of continued operation for any particular year. The advance royalty for each lease shall be based on a percent of the value of a minimum number of tons of coal, and the percent shall not be less than the percent prescribed in that lease for the production royalty. For any lease issued after August 4, 1976, the maximum number of tons shall be determined on a schedule sufficient to exhaust the leased reserves in 40 years from the approval date of the LMU mining plan

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of which the lease is a part; for any lease issued before August 4, 1976, the minimum number of tons shall be determined on a schedule sufficient to exhaust the leased reserves in 40 years from June 1, 1976. Advance royalties shall not be paid for more than 10 years in all during the life of any lease, including the life of the lease after readjustment. No payment of an advance royalty during the first 20 years of a lease may be used as credit against production royalty due after the 20th year of that lease. The Mining Supervisor may, upon notifying the lessee six months in advance, cease to accept advance royalties in lieu of the requirement of continued operation.

(c) An overriding royalty interest shall not be created by assignment or otherwise that (i) exceeds 50 percent of the rate of royalty first payable to the United States under the lease or (ii) that, when added to any other overriding royalty interest, exceeds that percentage, except that where an interest in the leasehold or operating agreement is assigned, the assignor may retain an overriding royalty in excess of the above limitation if he shows to the satisfaction of the Bureau of Land Management that he has made substantial investments for improvements on the land covered by the assignment that would justify a higher payment.

(d) (1) In order to encourage the greatest ultimate recovery of coal, and in the interest of conservation, the Secretary of the Interior may waive, suspend, or reduce the rental or minimum royalty or reduce the royalty on an entire leasehold, or on any deposit, tract, or portion thereof segregated for royalty purposes if the lease cannot be successfully operated under the rental or royalty terms of the lease.

(2) An application for any of the above benefits shall be filed in triplicate in the office of the Mining Supervisor. The application shall contain the serial number of the leases, the BLM State Office name, the name of the record title holder and operator or sublessee, and the description of the lands in the manner provided by Section 3471.1.

(i) Each application shall include the number and location of each mine, a map showing the extent of the mining operations, a tabulated statement of the coal mined and subject to royalty for each month covering a period of not less than 12 months immediately prior to the date of filing of the application, and the average production per day mined for each month with complete information as to why the minimum production was not attained.

(ii) Every application shall contain a detailed statement of expenses and costs of operating the entire lease, the income from the sale of coal, and all facts indicating whether the mines can be successfully operated upon the royalty or rental fixed in the lease. Where the application is for a reduction in royalty, full information shall be furnished as to whether royalties or payments out of production are paid to other parties than the United States, the amounts so paid, and efforts made to reduce them, if any.

(iii) The applicant shall also file a copy of agreements between the lease holders and the holders of any royalty interests to a permanent reduction of all other royalties from the leasehold so that the total royalties owed all private holders of royalty interests will not be in excess of one-half the Government royalties.

§ 3473.4 Suspension of operations, production and payment obligations.

(a) Applications by lessees for relief from any operating and producing requirements of coal leases shall be filed in triplicate in the office of the Mining Supervisor. By Departmental Order No. 2699 and Geological Survey Order No. 218 of August 11, 1952, the Mining Supervisor is authorized to act on applications for suspension of operations or production, or both, filed pursuant to this section and to terminate suspensions of this kind which have been or may be granted.

(b) The term of any lease shall be extended by adding any period of suspension of all operations and production during such term in accordance with any direction or assent of the Secretary.

(c) A suspension shall take effect as of the time specified in the direction or assent of the Secretary. Rental and minimum royalty

payments will be suspended during such period of suspension of all operations and production, beginning with the first day of the lease month on which the suspension of operations and production becomes effective. If the suspension of operations and production becomes effective on any date other than the first day of the lease month, rental and minimum royalty payments shall be suspended beginning with the first day of the lease month following such effective date. The suspension of rental and minimum royalty payments shall end on the first day of the lease month in which operations or production is resumed. Where rentals are creditable against royalties and have been paid in advance, proper credit shall be allowed on the next rental or royalty due under the lease.

(d) No lease shall expire only by reason of a suspension of either operations or production pursuant to any direction or assent of the Secretary.

(e) The minimum annual production requirements of a lease issued under the act shall be proportionately reduced for that portion of a lease year for which suspension of operations and production is directed or granted by the Secretary in the interest of conservation.

Subpart 3474 - Bonds

§3474.1 Bonding requirements.

(a) Before a lease or license may be issued, one of the following forms of bond shall be furnished:

(1) Corporate surety bonds.

(2) Cash.

(3) Personal lease bonds secured by negotiable U.S. bonds of a par value equal to the amount of the required surety bond, together with a power of attorney executed on a form approved by the Director.

(b) The applicant shall file the bond in the proper office within 30 days of receiving notice. An original bond shall be furnished on a form approved by the Director.

(c) The period of liability for the compliance bond shall not be terminated until the lease account is in good standing.

(d) The bonding obligation on a lease may be met by an adjustment of an existing bond on an existing lease that will be part of the same logical mining unit.

§ 3474.2 Type of bond required.

(a) A lease bond, conditioned upon compliance with all provisions of the lease except reclamation, shall be furnished in the amount determined by the authorized officer. The amount of the bond may be changed if the authorized officer considers such a change to be proper and necessary.

(b) A reclamation bond may be required in accordance with 30 CFR Part 742 for exploration licenses pursuant to subsection 3410.3-7 of this chapter.

§ 3474.3 Qualified sureties.

A list of companies holding certificates of authority from the Secretary of the Treasury under the Act of July 30, 1947 (6 U.S.C. 6-14) as acceptable sureties on Federal bonds is published annually in the FEDERAL REGISTER.

§ 3474.4 Default.

(a) When the surety makes payment to the Government of any indebtedness due under a lease, the face amount of the surety bond and the surety's liability thereunder shall be reduced by the amount of such payment.

(b) The authorized officer will notify those leaseholders who have nationwide or statewide bonds of the requirement to secure a separate bond for each lease area in the amount that is determined to be proper and necessary.

EXAMPLE REGULATIONS

Subpart 3475 - Lease Terms.

§ 3475.1 Duration of Leases.

Leases shall be issued for a period of 20 years and so long thereafter as the condition of continued operation is met. If the condition of continued operation is not met the lease will be cancelled as provided in Section 3452.2 of this chapter.

§ 3475.2 Dating of Leases.

(a) Leases will be dated and made effective the first day of the month following the date signed by the authorized officer. However, upon receipt of a prior written request, the authorized officer may date a lease to be effective on the first day of the month in which it is signed.

(b) Future interest leases shall become effective on the date of vesting of title to the minerals in the United States as stated in the lease.

§ 3475.3 Land description.

Compliance with Section 3471.1 is required.

§ 3475.4 Diligent development and continued operation.

(a) Section 7 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 207), provides that each coal lease shall require (1) diligent development, and (2) either continued operation or in lieu thereof, when the Secretary determines that the public interest will be served, payment of an advance royalty. Provisions for advance royalties are described in Section 3473.3-2(b).

(b) Each coal lease shall be subject to the requirements of diligent development and continued operation and shall remain subject to the requirement of continued operation except when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee.

(c) For coal leases issued before August 4, 1976, the 10-year period for achieving diligent development may be increased as follows:

(1) Upon application by the lessee, the 10-year period shall be extended by an amount of time equal to the period during which diligent development is, in the opinion of the Secretary, significantly impaired by (i) a strike, the elements, or casualties not attributable to the lessee, (ii) an administrative delay in the Department which is not caused by the lessee's action, or (iii) extraordinary circumstances not attributable to the lessee and not foreseeable by a reasonably prudent operator. In determining whether any of the conditions listed in subdivisions (i), (ii), and (iii) of this paragraph occurred and whether one or more of those conditions did, in fact, significantly impair diligent development, the Secretary's finding shall be final. The Secretary shall, however, not find to be an extraordinary circumstance under subdivision (iii) any condition arising out of normally foreseeable business risks such as: fluctuations in prices, sales, or costs, including foreseeable costs of compliance with requirements for environmental protection; commonly experienced delays in delivery of supplies or equipment; or inability to obtain sufficient sales.

(2) Upon application by the lessee, the Secretary may grant one extension, not exceeding five years, of the 10-year period because of (i) time needed to complete development of advanced technology, e.g., in situ, gasification or liquefaction processes; (ii) the large magnitude of the project (ordinarily large magnitude means a mine in which the production in the first year after the end of the extended period for diligent development is expected to be at least two million tons if an underground mining operation or five million tons if a surface mining operation); or (iii) a contract which is a firm commitment for the sale or use of the first one-fortieth of the LMU reserves after the 10-year period. Regardless of the reason for granting an extension, the lessee shall produce the first one-fortieth of the LMU reserves before the end of the extended term.

(d) At the time when the Secretary grants an extension under paragraphs (b) and (c) of this section, the lessee shall be notified of the revised date by which coal shall be produced in commercial quantities.

§ 3475.5 Logical mining unit.

(a) Criteria for approving or directing establishment of an LMU are found in 30 CFR 211.80. Every Federal coal lease shall automatically be considered to constitute an LMU as of the effective date of the lease or June 1, 1976, whichever is later. The lease may, at a later date, be included in an LMU with other Federal coal leases or with interests in non-Federal coal deposits, or both. An LMU containing any interest other than a single Federal lease shall become effective only at the direction of the Mining Supervisor or upon its approval by the Mining Supervisor when requested by the lessee. The Mining Supervisor shall not direct or approve the establishment of such an LMU unless it is determined that the maximum economic recovery of all Federal deposits in the LMU will be served. The boundaries of an LMU may later be changed either upon application by the lessee and with the approval of the Mining Supervisor after consultation with the authorized officer, or by direction of the Mining Supervisor after consultation with the authorized officer.

(b) When a Federal coal lease is included in an LMU with other Federal coal leases or with interests in non-Federal coal deposits, the terms and conditions of the lease shall be amended so that they are consistent with the requirements imposed on the LMU of which it has become a part. In particular, diligent development, continued operation, and production in commercial quantities anywhere within the LMU, with respect to either Federal or non-Federal coal deposits, shall be considered to have occurred on each Federal lease in the LMU. The rental and royalty payments of all Federal leases in an LMU shall be combined, and advance royalties paid on any Federal lease in that LMU may, at the request of the operator of the LMU, be credited against those combined royalties.

(c) The lessee may, upon approval of the authorized officer, surrender the rights to any coal deposits. If these rights are surrendered, the LMU reserves shall be adjusted. When the Mining Supervisor is determining the LMU reserves, the lessee shall be consulted about any coal deposits subject to the lease which the lessee does not intend to mine. The lessee shall also be consulted about the rights the lessee is prepared to surrender to decrease the LMU reserves upon which the requirements of diligent development, continued operation, and production in commercial quantities will be based.

APPENDIX B

MEMORANDUM OF UNDERSTANDING BETWEEN THE DEPARTMENT OF THE INTERIOR AND THE DEPARTMENT OF ENERGY CONCERNING THE ESTABLISHMENT AND USE OF PRODUCTION GOALS FOR ENERGY RESOURCES ON FEDERAL LAND

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MEMORANDUM OF UNDERSTANDING BETWEEN THE DEPARTMENT OF THE INTERIOR AND THE DEPARTMENT OF ENERGY CONCERNING THE ESTABLISHMENT AND USE OF PRODUCTION GOALS FOR ENERGY RESOURCES ON FEDERAL LANDS

1. Purpose

The purpose of this Memorandum of Understanding between the Department of the Interior (DOI) and the Department of Energy (DOE) is to set forth concepts, assumptions, and responsibilities for the establishment and use of production goals for Federal energy leasing and to set forth mechanisms for implementing those responsibilities.

2. Concepts and Assumptions

- a. The development of an integrated national energy policy by the Department of Energy requires the coordinated treatment of Federal resources as a constituent part of national energy planning consistent with overall national economic, environmental, and social goals and applicable law. These energy and resource development activities must be based on adequate data, rigorous analysis, and appropriate program decisions.
- b. Each Department has responsibilities, authorities, information, and data which, when properly combined and executed, can produce efficient energy resource development in an environmentally acceptable manner.
- c. The planning process must reflect the statutory responsibilities of each Department and the inherent uncertainty of forecasts as well as include public consultation, environmental considerations, and appropriate energy resource development.
- d. Program goals should be reviewed on a regular basis.
- e. Energy resources for purposes of this Memorandum include offshore oil, offshore natural gas, onshore oil, onshore natural gas, coal, oil shale, tar sands, geothermal resources, and uranium. Leases include leases of Federal lands (including Outer Continental Shelf (OCS) lands) or interests in such lands.
- f. Projection periods for onshore and offshore oil and natural gas, coal, oil shale, and geothermal resources are 5, 10 and 15 years each; projection periods for tar sands and uranium will be specified in the individual information exchanges between the Departments on an *ad hoc* basis.
- g. Production goals are the objectives for the national production of energy resources from Federal lands or interests in lands including the OCS which are necessary to carry out national energy policy and to enable each Department to fulfill its responsibilities under section 801 (b)(1) of the Department of Energy Organization Act.

3. Data Responsibilities of the Secretary of the Interior

a. The Secretary of the Interior will supply data and information (including supporting analyses and methodology) to the Secretary of Energy related to the extent of energy resources and current and anticipated production from the Federal lands, including OCS lands, or interests in such lands for the relevant projection period for each resource, consisting of:

- (1) Estimated energy resources and estimates of anticipated annual production for the 5th, 10th and 15th projection years expected from leases currently under production and from leases expected to be developed, taking account of changes due to exhaustion of resources and abandonment of leases, under existing and proven technology and under existing laws and regulations. Where necessary, explanations of uncertainties as to estimates and data will be included; and
- (2) Estimated energy resources underlying areas not currently under lease but which are included in a leasing schedule or plan.

b. The Secretary of the Interior will also provide to the Secretary of Energy the following data and information, to the extent available:

- (1) An evaluation of the energy resource potential of Federal lands neither currently under lease nor included in an established lease or schedule;
- (2) Any other related data that may be requested by the Secretary of Energy in carrying out his pertinent statutory and regulatory duties.

4. Goal Setting Responsibilities of the Secretary of Energy

Subject to the process and timetable provided in Section 6:

- a. The Secretary of Energy will develop proposed national energy production goals for Federal lands and, following review of those goals by the Secretary of the Interior, will establish final production goals.
- b. The Secretary of Energy will propose and establish production goals for energy resources, on a resource by resource basis, on lands or interests in lands under Federal jurisdiction, for the relevant projection period, based upon the following.

- (1) The production estimates provided by the Secretary of the Interior;
 - (2) Production estimates, developed by the Secretary of Energy, from Federal lands scheduled by the Secretary of the Interior to be leased;
 - (3) Increases or decreases in these estimates resulting from modification to pertinent regulations or statutes, anticipated advances in technology, or use of enhanced recovery methods; and
 - (4) Any additional increases or decreases in production which the Secretary of Energy may propose.
- c. In setting these goals, the Secretary of Energy will take into account developmental lead times and will consider:
- (1) The overall energy strategy set forth in the current or most recent Annual Report and National Energy Policy Plan prepared in accordance with sections 657 and title VIII of the Department of Energy Organization Act;
 - (2) The estimates, evaluations and other information provided by the Secretary of the Interior pursuant to section 3;
 - (3) Estimates, information, data and evaluations furnished by the Administrator of the Department of Energy's Energy Information Administration concerning, but not limited to, reserves and undiscovered resources;
 - (4) Such other considerations as the Secretary of Energy may deem pertinent; and
 - (5) With respect to coal, and as available and applicable for the other energy resources:
 - (a) The availability of the energy resource from private, State, Indian, and other non-Federal reserves already leased but not yet committed to production;
 - (b) The impact on potential production from non-Federal resources or on those Federal resources already leased but not yet committed to production, of leasing for production of additional Federal energy resources.
- d. The Secretary of Energy will provide the Secretary of the Interior the assumptions and data used in developing the production goals.
- e. The Secretary of Energy will include appropriate proposals on matters within his jurisdiction to adjust production, including, if applicable:
- (1) Changes in regulations identified by section 302(b) of the Department of Energy Organization Act.
 - (2) Changes in procedures for setting production rates, or changes in the rates themselves; and
 - (3) In the Annual Report and National Energy Policy Plan required by section 657 and title VIII of the

Department of Energy Organization Act, proposals for changes in legislation or other actions affecting the broad aspects of energy policy for which the Department of Energy has responsibility.

5.

In reviewing and commenting on the Secretary of Energy's proposed production goals, the Secretary of the Interior will inform the Secretary of Energy of potential policy conflicts or problems concerning, but not limited to:

- a. The Department of the Interior's responsibilities for the management, regulation, and conservation of natural resources;
- b. The capabilities of the Federal lands and Federal energy resources to meet these goals;
- c. The national need for these energy resources balanced against the environmental consequences of developing them.

6. Process and Timetable

- a. As soon as practicable after the effective date of this Memorandum the Secretary of the Interior will provide the Secretary of Energy the information, data, and assessments pursuant to section 3.
- b. Within 30 days after receipt of the Secretary of the Interior's information, data, and assessments regarding a particular energy resource, the Secretary of Energy shall advise the Secretary of the Interior of the time schedule for his preparation of proposed production goals. Such production goals shall be transmitted to the Secretary of the Interior as soon as practicable after receipt by the Secretary of Energy of the above mentioned information.
- c. The Secretary of the Interior will have 60 days to review and comment on the proposed production goals.
- d. The Secretary of Energy will issue final production goals not more than 30 days after the Secretary of the Interior's comments have been received.
- e. This process will be repeated biennially from the effective date of this Memorandum or at such other interval as the Secretaries may agree.
- f. The final production goals will be published in the current or next Annual Report or National Energy Policy Plan of the Secretary of Energy under section 657 and title VIII of the Department of Energy Organization Act.
- g. In establishing or revising leasing programs and lease planning schedules, the Secretary of the Interior shall be guided by the final production goals established pursuant to this Memorandum consistent with the Secretary's other statutory responsibilities.

7. Coordination

Coordination of these procedures *may be* accomplished through the Leasing Liaison Committee established in accordance with section 210 of the Department of Energy Organization Act.

8. Effective Date

This Memorandum shall be effective upon execution.

S/James R. Schlesinger

Secretary of Energy

9/9/78

(Date)

S/Cecil D. Andrus

Secretary of the Interior

8/31/78

(Date)

MEMORANDUM OF UNDERSTANDING BETWEEN THE BUREAU OF LAND MANAGEMENT AND THE FISH AND WILDLIFE SERVICE ON COAL

I. PURPOSE

The purpose of this agreement is for the Bureau of Land Management (BLM) and the Fish and Wildlife Service (FWS) to assure the effective consideration of fish and wildlife resources in coal related activities on public lands in a manner that recognizes existing cooperative relationships with the States. It is also to promote harmonious working relationships and program efficiency in the public interest.

A. Responsibilities

The key to achieving the purpose of this agreement is clear definition of BLM and FWS roles and responsibilities within respective statutory authorities. Broad responsibilities are defined below. Specific responsibilities and relationships are set forth in section II of this agreement.

1. The BLM has the statutory responsibility for inventory, planning, and multiple-use management of the public lands and public land resources, including coal and fish and wildlife. In connection with this responsibility, BLM must have the capability to efficiently inventory, manage and protect fish and wildlife habitat.
2. FWS has statutory responsibilities for protection of migratory birds, including eagles, and threatened or endangered species and their habitats. The Fish and Wildlife Coordination Act responsibilities of FWS extend to some water development projects on public lands.
3. FWS and BLM have general responsibilities to conduct research and to compile information on the status of the fish, wildlife and plant resources and those factors affecting them in their respective area of responsibility. These general assessments for wildlife and vegetative conditions and trends extend to concerns within major coal regions.
4. Both Agencies have wildlife advocacy roles within their statutory authorities or other assigned functions.

B. General Principles

1. The cooperative relationship between the two Agencies is built upon the concept that field level input into the BLM land use planning system will achieve the basic objectives of each Agency, and the Department of the Interior (DOI). The BLM has a statutory responsibility to see that fish and wildlife resources are effectively considered in all stages of its land management programs and activities. Procedures consistent with this MOU will be established by BLM State Directors and FWS Regional Directors to provide for regular exchange of information and advice as early as feasible in the

BLM planning process. FWS input will reflect BLM's responsibility of the need to balance wildlife interests with other concerns in coal development and multiple-purpose land management. In those cases where there are disagreements, such disagreements should be expressed through the chain of command of the two Agencies beginning at the lowest appropriate field level.

2. BLM has responsibility for assuring the collection, inventory, and subsequent analysis of fish, wildlife and vegetative data on the public lands. FWS also has responsibilities for collection and analysis of data to meet its requirements. FWS concerns in this area relate to the adequacy of the data and analysis as these relate to responsibilities of FWS relative to endangered species, migratory birds, and other species. FWS is also concerned with the general adequacy of data and analysis for management and protection of wildlife, wildlife habitat, and threatened and endangered plant species on a national and regional basis. These responsibilities and concerns can best be met by FWS participation in appropriate components of the planning system as identified in subsequent sections of this MOU. Both Agencies will coordinate inventory system development and applicable data gathering activities to foster a common and compatible resource data base, to share information, and to minimize conflicts and disagreements concerning adequacy of wildlife data related to coal development decisions from the outset. BLM will seek FWS participation in the actual conduct of data collection activities to meet its requirements where such participation is mutually advantageous. In turn, FWS will seek BLM participation in data collection and analysis to meet its requirements where it is appropriate.
3. The BLM State Offices and the FWS Regional Offices or their delegated Offices will be the primary Offices through which field coordination will take place. Each is responsible for ensuring that appropriate Offices of their organization are involved whenever appropriate. On matters pertaining to coal related field studies or investigations, the FWS Regional Director or the BLM State Director will determine which items of mutual interest are administered by their respective Office and which items should be referred to other field organizational units (i.e., BLM Denver Service Center, FWS Research Centers and National Teams). Upon referral, the Directors or Leaders of the field unit will be the coordination focal point for that activity or activities within the respective

Bureaus. Additionally, the Directors or Leaders of these field units will apprise FWS Regional Directors and BLM State Directors of planned or ongoing coal related studies, projects, and activities. Frequent informal consultation on matters of mutual concern is to be encouraged at all levels.

4. BLM State Directors and FWS Regional Directors will keep each other apprised of actions planned or taken with State wildlife agencies on wildlife matters of concern in coal areas. Whenever coal-related research actions and nonoperational studies are proposed with State wildlife agencies by field units within BLM and FWS that are not administered by the FWS Regional Director or BLM State Director, it shall be the responsibility of the Director or Leader of that field unit to keep both the Regional and State Director informed. BLM will ensure State wildlife agency involvement in the coal programs. Officials of both Agencies will also keep each other informed of their respective activities relating to coal resources on public lands.
5. FWS will otherwise assist BLM in a manner consistent with this MOU, through cooperative procedures mutually agreed by BLM State Directors and FWS Regional Directors, or as appropriate, Directors or Leaders of other BLM or FWS field units. Some examples include participation in certain field projects, providing highly specialized expertise, developing methodologies for data collection and interpretation and assessing major impacts on wildlife for preventing or mitigating damage to important habitats, and conducting and sharing research findings to support BLM identified needs.

C. General Coordination

1. *Meetings.* There shall be annual coordination meetings between State and District BLM Offices and appropriate FWS Regional and Area Offices, and such other Offices as deemed appropriate, timed to coincide with the budget cycle, to discuss programs and plans relative to coal and other items of mutual concern to both Agencies. WO level meetings shall be held by the BLM/FWS Coordinating Committee.
2. *Written Communication.* When FWS advice/recommendations are solicited on subjects related to this agreement, the FWS will be afforded 30 days unless specified otherwise in which to make its views known to BLM to the extent time deadlines imposed on BLM permit. If no response is received within the 30 days or other specified time period, BLM will assume that FWS either concurs or has no comments to offer.
3. *Supplemental Agreements.* BLM and FWS field organizations or other appropriate organizational units may enter into supplemental agreements where needed to specify interrelationships in detail or for specific project type activities. Such agreements must be within the policy parameters of this

agreement. Both BLM State Directors and FWS Regional Directors will make every effort to ensure coordination is achieved at their lowest appropriate field units. Where mutually agreeable, BLM State Directors and FWS Regional Directors will delegate coordination functions to their field units.

II. FUNCTIONAL COORDINATION

This section outlines Agency responsibilities and working relationships by functional area.

A. Preleasing

1. Subject: Resource Inventories

- a. *Description:* Inventories must be conducted to determine the nature and extent of living and nonliving resources; to provide a basis for land use planning and decisionmaking; and to identify the nature, extent, and condition of all resources located in planning areas with potential for coal development.
- b. *Responsibilities:* The Federal Land Policy and Management Act (FLPMA) directs BLM to maintain resource inventories on a continuing basis. FWS has legislative responsibilities to conduct nationwide inventories related to migratory birds, wetlands, and threatened and endangered species. Both Agencies may also be assigned responsibilities for inventory via Presidential or Departmental direction. BLM has responsibility for inventory work relative to data necessary for public land management. This includes inventory and planning responsibilities for threatened and endangered species on public lands in coal areas pursuant to regulations regarding Section 7 of the Endangered Species Act (ESA). FWS will provide support in terms of cooperative development of new methodology and inventory techniques and supply applicable data to BLM. FWS Regional Directors and BLM State Directors will take steps to ensure that appropriate organizational units, e.g., FWS Area Offices and BLM District Offices will periodically coordinate their activities and capabilities. Joint efforts in this regard will be guided by the Interagency Agreement Relative to Classification and Inventory of Natural Resources, effective June 6, 1978. In accordance with that agreement, both Agencies will work in partnership to ensure that needed data are obtained in a cost effective and expedient manner.

The BLM's planning system contains several inventory steps applicable to coal activities. These steps, including their overall purposes, are outlined together with the nature of specific FWS inputs at the field or BLM planning unit levels:

Step	BLM Responsibility	FWS Input(s)
1. Preplanning Analysis	Determine wildlife resource data needs; develop planning/inventory schedule for wildlife resources; estimate financial requirements.	Help identify general wildlife situations in coal areas, and recommend data elements needed to address wildlife issues.
2. Unit Resource Analyses (URA)	Identification of existing wildlife resource conditions and potentials on planning area basis.	Help identify known significant wildlife habitats (existing and potential) and provide other assistance, technical support, and advice

2. Subject: Land Use Planning

a. *Description:* Land plans must be developed as a requisite for management and decisionmaking regarding allocation and use of resources located on public lands, in accordance with planning mandates in the FLPMA, the Federal Coal Leasing Amendment Act of 1975, and the Secretary's decision of October 22, 1977, which calls for plans prior to identification of lease tracts. In BLM, such plans are called management framework plans (MFP's).

b. *Responsibility:* The FLPMA directs development, with public involvement, of BLM land use plans which provide, by tracts or areas, for the use of the public lands. Such plans must address: multiple-use and sustained-yield, areas of critical environmental concern (ACEC), interdisciplinary concerns, present and potential uses for wildlife and other resources, and certain other requirements. To the extent consistent with law, these plans must be coordinated with land use inventory and management programs of other Federal Agencies and State and local governments. Therefore, FWS will provide comment on URA's/MFP's in potential coal production areas by participating in a consultative manner to minimize conflicts and disagreements. Such comments will be considered and incorporated, as deemed appropriate, into decisionmaking by BLM District Managers, as well as comments from other Federal and state agencies and private organizations.

3. Subject: Identification of Areas to be Excluded From Leasing and Lands Unsuitable for Mining

a. *Description:* Certain areas that may be excluded from leasing or identified as unsuitable for mining because of: (1) statutes or (2) policy determinations such as for high socioeconomic or ecological values associated with wildlife, archaeology, cultural and other resources, and (3) for reasons of public health and safety.

b. *Responsibility:* The FLPMA directs that critical environmental areas be identified during BLM land use planning. The Federal Coal Leasing Amendments Act requires planning prior to coal leasing. Also, the interagency agreement between BLM, Geological Survey (GS), and the Office of Surface Mining Reclamation and Enforcement (OSM), approved July 1978, delineates Agency responsibilities for identification of "areas unsuitable for mining" as directed by the Surface Mining Control and Reclamation Act (SMCRA). In accordance with these authorities and relationships, BLM must decide which areas of public lands are of environmental concern and, thus, may be unsuitable for mining or excluded from leasing.

The Department is providing BLM with criteria relative to land suitability for leasing. Such criteria will serve as a basis for unsuitability designations or excluding lands from leasing. Within the parameters of Departmental criteria, FWS may provide to BLM information which it feels should be considered in making these designations during the land use planning process.

4. Subject: Tract Selection

a. *Description:* This involves identification and selection of specific tracts for short and long term leasing, preference right leasing, and land use decisions by BLM District Managers. Selection of such tracts will be after decisions are reached on areas unsuitable for mining, or excluded from leasing.

b. *Responsibilities:* BLM is responsible for selection of tracts suitable for leasing after decisions are made as to "areas unsuitable for mining." Using information available through the land use planning process and from specific recommendations from FWS, States, and others, tracts will be selected, then ranked for priority of leasing. Thus, through participation in the planning and tract selection process, FWS will have opportunity to provide information and opinions in the tract decision process.

5. Subject: Lease Stipulations, Terms, and Conditions

a. *Description:* This involves preparing special terms regarding environmental performance standards and other protective provisions in coal related leases.

b. *Responsibility:* The FLPMA directs that all actions necessary be taken to prevent unnecessary or undue degradation of the public lands. BLM is the official representative of the Secretary in dealing with lease applicants and, as such, is responsible for placing protective provisions and stipulations on coal leases.

Such stipulations and provisions are developed and based upon decisions flowing from the MFP, upon findings in environmental impact analysis, and the technical examination.

BLM is responsible for incorporating stipulations and conditions into leases after consideration of all recommendations, including those from FWS. FWS recommendations or suggested modifications will be solicited for appropriate analysis in coal lease stipulations.

6. Subject: Environmental Analysis

- a. *Description:* This involves preparation of regional or, when warranted, site specific prelease environmental analysis reports (EAR) or environmental statements (ES) concerning lease tract selections.
- b. *Responsibilities:* Sec. 102(2)(c) of the National Environmental Policy Act (NEPA) requires agencies taking major Federal actions significantly affecting the quality of the human environment to prepare ES's on those actions. Extraction or mining of coal and related activities, such as issuance of rights-of-way and water developments to support such industrial activities are also among the actions to be considered. Present "lead agency" responsibilities for preparation of such analyses rest with BLM except in special exceptions where another agency may be designated as lead agency. These responsibilities must be carried out in consultation with all appropriate agencies and organizations, including the FWS. The following procedures are hereby established to ensure close working relationships between the two Agencies in this regard:

(1) BLM will keep FWS apprised of current and projected ES schedules via the regularly scheduled meetings of the FWS-BLM Coordinating Committee and other means, as appropriate.

(2) BLM will request FWS data and other inputs into the applicable ES's at the earliest possible date. Where FWS has special expertise or unique talent needed for the ES, such will be made available to the BLM ES team under terms and conditions mutually agreeable to the concerned FWS Regional Director and BLM State Director. This may include detail of FWS personnel to assist in ES preparation.

(3) FWS and BLM budget requests for ES's and associated work will be coordinated to reflect their respective responsibilities in the most cost-effective approach and to foster clear communications between the two Agencies. The FWS-BLM Coordinating Committee will be the principal vehicle for ensuring such coordination at the Washington Office (WO) level. Coordination at the field level will be in accordance with procedures agreed to by FWS Regional Directors and BLM State Directors.

(4) BLM will provide FWS review copies of draft ES's at the earliest possible time for official review and comment within specified time frames.

7. Subject: Endangered Species Consultation

- a. *Description:* BLM must consult with FWS on any action which may affect threatened or endangered species or their habitats.
- b. *Responsibilities:* Whenever it is found that threatened or endangered species or their habitat may be affected by coal leasing or mining activities, the concerned BLM State Director must initiate written formal consultation in accordance with Interagency Cooperation Regulations dated January 4, 1978. To the extent that the concerned BLM State Director and the FWS Regional Director can agree, and as provided for in the above regulations, an aggregate approach to consultation

in coal areas will be followed. Whenever FWS rules that additional data are needed upon which to issue a biological opinion, such data must be provided by BLM before the consultation process can be concluded. It is jointly agreed that not all habitat modifications are prohibited, only those which diminish habitat for the species in question. The FWS will provide methodology, expertise and recommendations, upon request, to help resolve operational problems caused by endangered species in coal areas.

B. Post Leasing

1. Subject: Compliance With Lease Stipulations

- a. *Description:* This involves monitoring exploration and associated activities to ensure compliance with lease stipulations and/or special terms and conditions.
- b. *Responsibilities:* BLM is responsible for ensuring that lessees abide by lease terms and conditions. Where in the course of other activities, FWS personnel find or become aware that a lessee is not in compliance with lease terms or conditions, such personnel should immediately advise the nearest BLM Office. The BLM will then take necessary action.

2. Subject: Emergency Environmental Situations

- a. *Description:* Some situations may arise in leased areas that involve either imminent danger to public health or safety or where conditions, practices, or violations of regulations or lease terms are causing or may cause significant, imminent environmental harm to land, air or water, or other resources or significant waste of coal. In such cases, it may be necessary to order cessation of such activities or violations and to order immediate remedial action.
- b. *Responsibility:* The BLM has such authority when authorized mine inspectors are unable to take action before significant harm or damage will occur. If in the course of other activities FWS personnel become aware that such conditions exist, the appropriate BLM State Director and/or District Manager is to be so informed immediately and will take appropriate action to resolve the situation.

3. Subject: Review of Reclamation Plans and Abandonment Procedures

- a. *Description:* Lessees must prepare adequate plans for reclaiming mined areas which meet the reclamation requirements of the SMCRA and multiple-use management requirements of FLPMA.
- b. *Responsibilities:* The OSM has primary Federal authority to inspect and approve abandonment procedures. BLM must concur in such abandonment procedures as related to protection and postmining use of the lands regarding fish, wildlife and other natural resources. BLM resource staffs will analyze the adequacy of such procedures. Where such procedures are found to be inadequate, BLM will suggest needed changes and improvements. FWS will be afforded an

opportunity to provide comments to BLM as to the adequacy of proposed procedures prior to BLM concurrence, in accordance with procedures agreed to by appropriate BLM and FWS field officials. BLM will notify/negotiate/ resolve with applicable agencies and groups, including FWS, any issues which would serve as grounds for BLM nonconcurrence.

III. RESEARCH AND DEVELOPMENT

Annual meetings shall be held at the field and WO levels to coordinate research surveys, investigations, and studies being conducted that are of mutual program interest to both Agencies. This includes such work being conducted by the FWS WELUT and the EELUT, cooperative research units, or other applicable entities of FWS and BLM's Denver Service Center. Such meetings shall be initiated, scheduled, and organized by mutual agreement of appropriate officials of both Agencies. Agenda items should provide for discussion/resolution of Agency needs and priorities relative to coal activities and associated wildlife considerations.

When it is of mutual interest, the FWS and the BLM may conduct cooperative research in coal areas.

Each Agency will be given an opportunity to identify and review research proposals relating directly to its lands or management responsibilities developed by the other for the purpose of avoiding duplication and to determine if similar research is being conducted by other agencies. Pertinent research results of either Agency will be made available to the other on a timely basis, including significant interim findings. The FWS will provide a periodic report summarizing wildlife research pertinent to coal.

IV. INFORMATION TRANSFER

It is recognized that a wide variety of biological, ecological, and scientific information, published and unpublished, exists within both Agencies. This includes information and data relating to resource conditions and trends, wildlife and habitat inventories and baseline studies, economic or other values, demand/supply, and use statistics. Free exchange of this information in compatible and standardized formats is essential.

It is, therefore, mutually agreed that procedures will be developed under the direction of the national BLM/FWS Coordinating Committee for more formalized transfer of information between BLM and the FWS at all levels.

V. PERMITS REGARDING WORK IN NAVIGABLE WATERS

The Secretary of the Interior has delegated to the FWS Director and Regional Directors authority to act for the Department in the review of and reporting on permit applications administered by the USA-CE (503 DM 1, August 3, 1973). Procedures and necessary evaluations of permit application for coal operations on public lands, as required under secs. 402 and 404 of the Federal Water Pollution Control Act and by the Rivers and Harbors Act of 1899, shall be coordinated at the FWS Area Office and BLM District

Office or other appropriate level before a formal application is made to the U.S. Corps of Engineers.

VI. RELATIONSHIPS TO STATE, OTHER AGENCIES, AND INSTITUTIONS

Nothing in this MOU is intended to modify in any manner the present or future cooperative programs of either Agency with States, other public agencies, or educational institutions. Both Agencies share the concern that State fish and wildlife resource agencies be consulted on a routine basis to strengthen coordination and cooperative relationships. Every effort will be made to prevent duplicative requests or contracts to these State agencies for information and data assistance relative to coal.

VII. OBLIGATION OF FUNDS

Nothing in this agreement shall be construed as obligating either party to the expenditure of funds in excess of appropriations authorized by law or otherwise commit either Agency to actions for which it lacks statutory authority.

VIII. EFFECTIVE DATE, REVIEW, AMENDMENT, AND TERMINATION

This agreement shall become effective upon the date subscribed by the last signatory, and shall remain in force until terminated by either Agency upon 90 days written notice. It shall be reviewed by all parties no later than Calendar Year 1981 for adequacy and timeliness. Amendments to existing wording within this agreement may be proposed by either Agency at any time and shall become effective upon joint approval.

IX. BUDGET COORDINATION

To insure maximum compatibility of budgetary requests and the subsequent distribution and utilization of funds, the following coordinating functions shall apply:

A. Joint Review of Budget Materials

1. Prior to formulating coal related budget instructions, the BLM and FWS shall jointly review the coal program to determine program objectives and budget assumptions.
2. Each Agency shall provide the other an opportunity to review budgetary material relating to all activities on behalf of coal leasing and coal development. Where coal related work is supported by a number of activities, these will be identified to facilitate review of budgetary plans.
3. To the extent possible, review opportunity shall be given sufficiently in advance of budgetary due dates to permit meaningful input and discussion before such budget material must be finalized.
4. Neither Agency shall advance a program which is directly linked or referenced to the activities, actions, or authorities of the other Agency without advance consultation and mutual understanding as to the nature of that program and actions to be undertaken within the scope of this agreement.
5. Budget materials as used herein apply to Departmental Program Strategy Papers, Office of

Management and Budget (OMB) Estimates, Budget Justifications for Congressional review, and any amendments or supplementals thereto.

B. *Budget Year Consultation*

1. Where the budget (or appropriations act) for the upcoming fiscal year (FY) in one Agency contains funds or positions earmarked for direct transfer to other Agency, such funds and positions shall be identified in writing prior to the start of the FY for budget planning.
2. Where funds and manpower are to be retained in the Agency, but are to be committed toward those efforts related to coal leasing and coal development, each Agency shall, to the extent known, inform the other as to the approximate level of direct funding, its distribution, and expected accomplishments for the upcoming FY. Each Agency's plans shall be

communicated to respective field offices to facilitate further coordination at the State-Regional level.

3. Funds earmarked for cooperative research shall be identified and transferred to the Agency designated as "lead Agency" for the research project.

C. *Coordination Points*

Coordination activities, as described in this section, shall be the primary responsibility of:

For BLM - Chief, Division of Budget and Program Development
and

For FWS - Assistant Director - Planning and Budget

X. **CONFLICT RESOLUTION**

Should interagency controversy arise at any working level, the facts regarding such controversy shall be forwarded to the next higher level of authority for resolution.

9/26/78

Date

S/Frank Gregg

Director, Bureau of Land Management

9/26/78

Date

S/Lynn A. Greenwalt

Director, Fish and Wildlife Service

I CONCUR:

S/Guy R. Martin

Assistant Secretary, Land and Water Resources

10/2/78

Date

S/Robert L. Herbst

Assistant Secretary for Fish and Wildlife and Parks

10/3/78

Date

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APPENDIX C

COAL TECHNOLOGY BACKGROUND INFORMATION

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COAL TECHNOLOGY BACKGROUND INFORMATION

C.1 IMPORTANT COAL CHARACTERISTICS

Coal is a readily combustible mineral containing more than 50 percent by weight and more than 70 percent by volume of carbonaceous materials including inherent moisture formed from compaction and induration of variously altered plant remains similar to those in peat [1]. Character and quality (as defined by rank and grade) are the factors that determine the relative value and usefulness of coal. These factors are controlled principally by conditions during formation and the depth of burial of the coal.

Coal is classified according to a particular property such as degree of metamorphism or "coalification" (rank), constituent plant materials (type), or degree of impurity (grade). The rank of a particular coal is established according to the percentage of fixed carbon and the peat content, calculated on a mineral-matter-free basis. As shown in Figure C-1, the percentage of fixed carbon and the heat content (measured in British thermal units, Btus) increases from low rank lignite to higher rank bituminous coal as the percentages of volatile matter and moisture decrease. Coal is classified by grade largely according to the content of ash, sulfur, and other constituents.

C.2 MINING TECHNOLOGY

Exploration, development, production, and reclamation are the four operations executed during the life of a coal mine. These operations are described in the following sections.

C.2.1 Exploration

Generally, exploration aims at locating the presence of economic deposits and establishing their nature, shape and grade. There are three broad phases which comprise mineral exploration—initial appraisal, preliminary reconnaissance, and detailed physical sampling [3].

C.2.1.1 Initial Appraisal. This step involves literature search and the review of maps (geological, geographical, hydrological, etc.) to ascertain factors relating to surface and mineral ownership, access routes, seam thickness, seam pitch, surface contours, overburden thickness and composition, the presence of other minerals, as well as surface and groundwater flows.

C.2.1.2 Preliminary Reconnaissance. If the initial appraisal looks promising, a preliminary field visit is made to check surface hydrology, the location of coal outcrops, and unusual obstacles such as areas of archeological or cultural interest. A series of spot or information drillings may be made for better determination or stratigraphy and coal seam thickness. Chemical and calorific checks of outcrops and/or drilling samples are also made.

C.2.1.3 Detailed Physical Sampling. As the expectation for profitably extracting coal increases, more drillings are made to verify physical and chemical characteristics and map the coal seam. A set of outline drillings are made to ascertain the dimensions of the deposit and amount of reserves. These may then be followed by sampling drillings to determine the necessary parameters with enough certainty that reliable economic appraisals are possible. In general, coal deposits require less drilling than other minerals because coal is fairly consistent in thickness and quality and wider spacing can be tolerated between exploratory holes. In some instances, drilling on 1/4 mile centers is satisfactory; this is unique in mineral extraction programs since 200-foot centers are usually required. Besides the mineralogical, chemical and physical testing of drill core samples and outcrop cuttings, there are several types of downhole or bore hole tests which can be made with instruments lowered into the drill hole. These experiments involve devices making seismic, gravimetric, magnetic, and electrical resistance readings of the different underground strata.

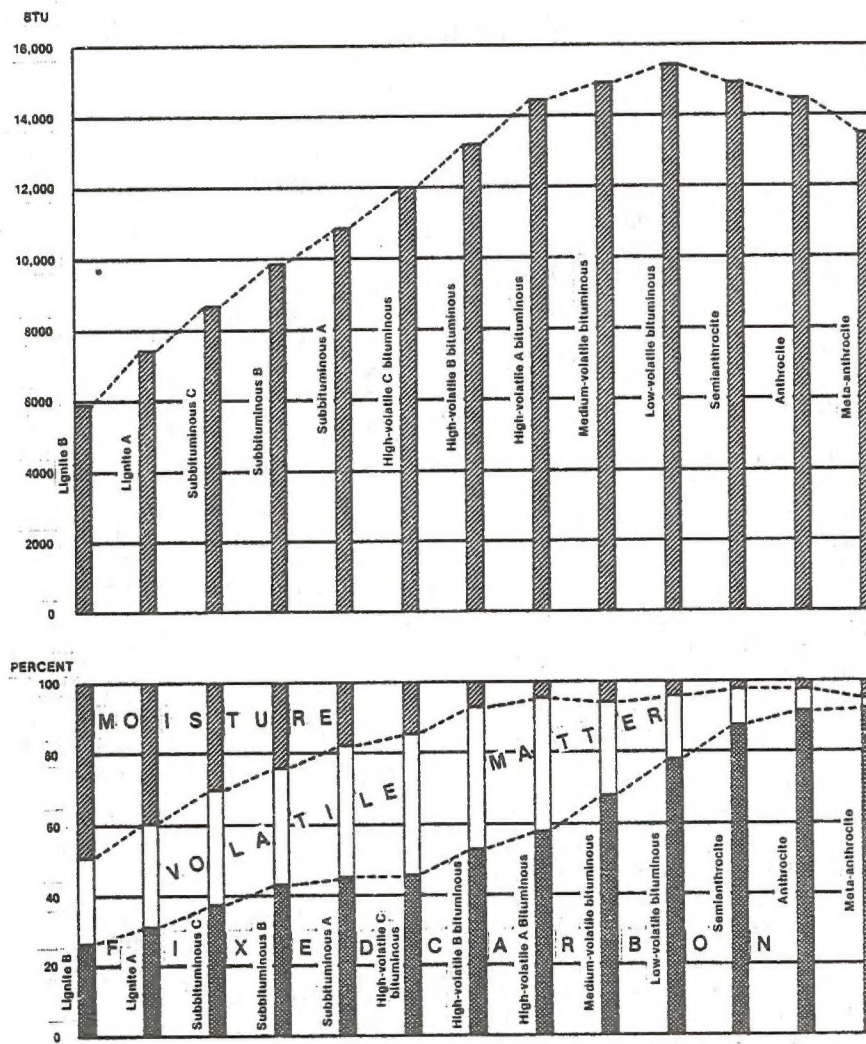
Exploratory drilling is generally done with truck-mounted rotary rigs, and the samples taken with such rigs can be either cuttings or core, or both. Additional equipment used by an exploration crew may include water trucks, personnel carriers, a hole-logging equipment truck, and a dozer or grader to assist in obtaining access to the exploration area and to prepare the drill site.

C.2.2 Mine Development

Development, the operation preparatory to production, begins after a promising coal deposit has been found. Actual development cannot begin until all necessary arrangements have been made with Federal, state and local governments as well as any private owners that may be involved. Such arrangements include obtaining a lease; providing access to the mine property for roadways, railroad, utilities; and obtaining the permits and licenses required by Federal, State, and local authorities. A usual requirement is that a mining and reclamation plan be approved before a permit is granted. Bond is posted to insure payment of rents, royalties, and land reclamation costs as mining progresses.

Planning, the first stage of development, involves specifying how the development work is to be accomplished, the method and equipment to be used for mining, the design of above-ground facilities, the plan for prevention of air and water pollution, and the provisions for reclaiming disturbed land.

After planning, the development of a mine includes construction of roads, utility line tie-ins, and the mine plant. Depending on the amount of coal produced and where it is to be used, construction of a railroad spur may be required. For coal that contains excessive impurities, a washing plant could



Source: Reference Number 2.

FIGURE C-1
COAL CLASSIFICATION BY RANK

be constructed as part of the mine plant. Otherwise, the mine plant consists of coal handling and storage facilities, offices, shops and laboratories, equipment storage buildings, and waste disposal areas. If the coal is to be mined by underground methods, the mine plant is constructed near the main portal or entrance. For coal mined by surface methods, the mine plant would be located off the outcrop if possible.

Access to coal deposits at an underground operation is provided by either drifts, slopes, or shafts (Figure C-2). The coalbed is developed for further operations by driving entries. Although terminology varies, the following system of entries is universal in the industry. Main entries are extensions of the access openings and often run several miles in one direction. Three or more parallel entries, 12 to 22 ft. wide and 40 to 100 ft. between centers, are driven in a given direction and connected at intervals by crosscuts to provide proper air circulation. These are the major routes of underground transport and access, and serve for the life of the mine [1]. Panel entries are driven from the main entries, resulting in a subdivision of the coalbed into blocks or panels having dimensions that may be as much as 1 by 1/2 mile. Panel entries serve as routes from main entries to the working places and for air circulation. Although coal is removed during the driving of both the main and panel entries, it is with completion of the panel entries that the production cycle begins.

Access to coal deposits at a surface operation involves the use of large equipment such as bucket-wheel excavators, draglines and shovels to remove overburden from the coal so extraction can begin. As mining progresses, development mainly consists of extending paved roads and power lines, and constructing new roads to access the coal deposit.

C.2.3 Coal Production

This section addresses the primary operations of extracting the coal from a deposit and preparing it (cleaning and purifying it) for shipment and use.

C.2.3.1 Extraction. There are two major methods of extracting coal: by underground mining methods or surface mining methods. Associated with each method are a number of alternatives.

Underground Mining. In underground mining, after the initial development has gained access to the coalbed, one of three methods, i.e., room-and-pillar, longwall, and shortwall, are commonly used to extract the coal.

Room-and-pillar mining has been used in the United States longer than any other underground method. Mining is accomplished by driving entries off the panel entries. As mining advances, rooms are excavated in the coal seam; the strata above the seam are supported by pillars of coal left in place. After a block panel or section has been mined, part of the coal in the pillars can be recovered as a retreat is made toward a main entry (Figure C-3). Until about 1950, most of the coal produced from underground mines was by this conventional technique. Since then, conventional mining gradually has been replaced by more mechanized, continuous mining. Conventional mining requires driving a number of entries so that each operational phase, i.e., undercutting, drilling, placing explosives, blasting, loading the shot coal, and

roof bolting, can be done simultaneously. Continuous mining is performed by electric-powered machines that either bore, dig, or rip the coal from the working face. As shown in Figure C-3, many of the operations performed in separate panels with the conventional technique are performed simultaneously in the same panel with the continuous technique. Such machines are usually crawler-type vehicles operated by one man. They either load the coal directly into a shuttle car or pile it behind the machine where it is loaded separately onto the shuttle cars. True continuous operation of a mining machine cannot be achieved, however, because stops are required to support the roof, await haulage equipment, advance power and water supplies, change cutting bits, etc. Where the entire thickness of a coal seam is to be mined, recovery averages about 50 percent. However, it is not always possible to take all the coal in the seam because it may be necessary to leave part of it for roof support. This is common practice in seams greater than ten feet in thickness. Roof bolts and timber are used for additional support.

Contemporary longwall mining, first introduced to the United States in the 1950's, has long been practiced in European mines. To support the roof at the face, longwall mining originally used manually operated props, then gradually evolved to the presently used powered, self-advancing supports (Figure C-4). Longwall mining is used most efficiently in uniform coal seams of medium height (42 to 60 in.). As in the room-and-pillar method, longwall mining starts with sets of entries cut into the panel areas. The difference in the technique lies in the distance between these sets of entries and the method used to extract intervening coal. Longwall blocks range from 300 to 600 ft. wide and are sometimes a mile long. The longwall machine laterally shears or plows coal from the entire face, transports the fallen coal by an advancing conveyor to a secondary haulage conveyor, reverses direction at the end of a cut, and supports the roof in the area of the face by a self-advancing system of hydraulic jacks. The roof is allowed to cave behind the advancing work areas; the roof is occasionally blasted to ensure a controlled cave-in rate and to reduce overburden pressure on the coalbed being mined.

The shortwall method of mining coal, a relatively new innovation, is best described as a method similar to longwall mining with two exceptions. The blocks of panels are smaller, usually ranging from 100 to 150 ft. wide and 300 to 500 ft. long, and the coal is cut with a continuous miner and is loaded into shuttle cars.

Surface Mining. Strip and auger mining are the two most common surface methods of extracting coal in the United States. Two other methods, open-pit and quarry-type mining, are being tried in thick, shallow-lying western coal seams and may become generally accepted where conditions warrant their use.

Strip mining is accomplished by two techniques, area stripping and contour stripping (Figures C-5 and C-6). Where coalbeds are relatively flat and near the surface, as in much of the west, area stripping is the dominant technique [4]. In area strip mining, overlying material is removed from a seam of coal in long narrow parallel bands, or strips, followed by removal of the exposed coal. With the exception of the first cut (box cut), overburden from each cut is discarded in the

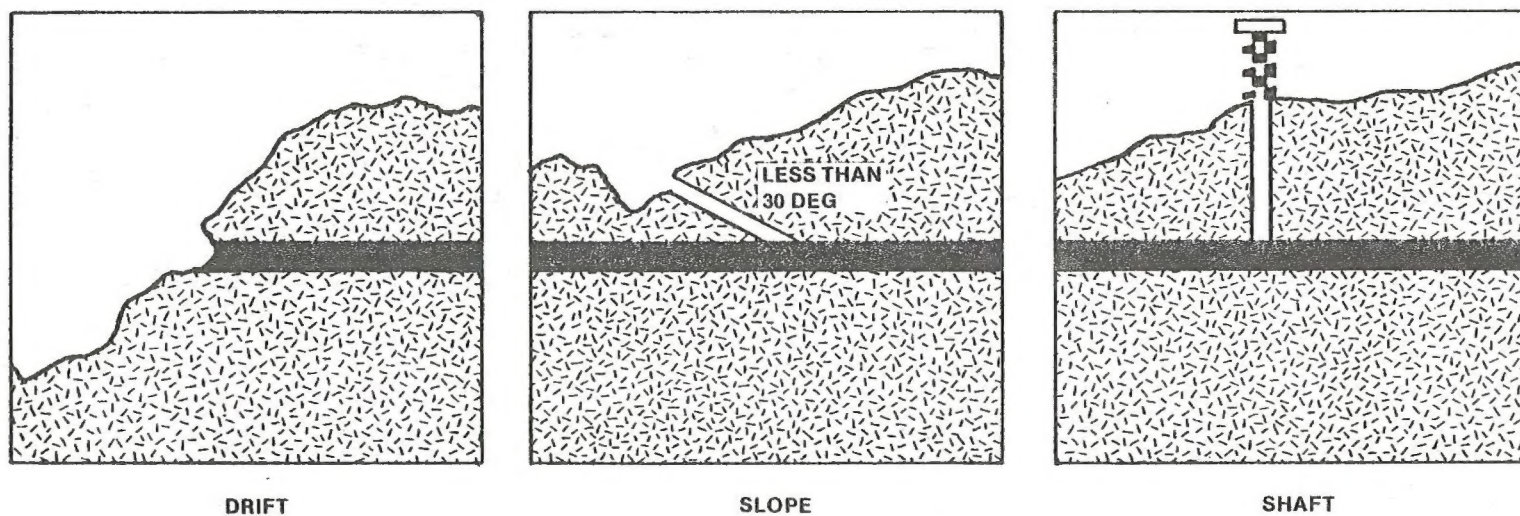


FIGURE C-2
THE THREE TYPES OF ACCESS USED
IN UNDERGROUND COAL MINES

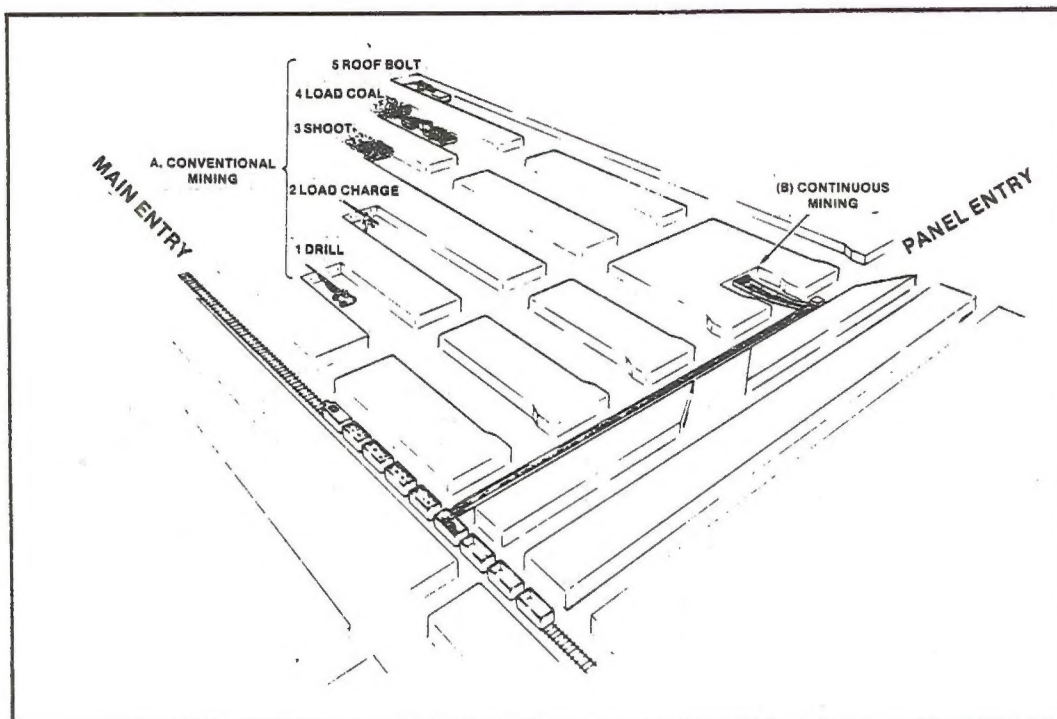


FIGURE C-3
ROOM-AND-PILLAR MINING TECHNIQUES

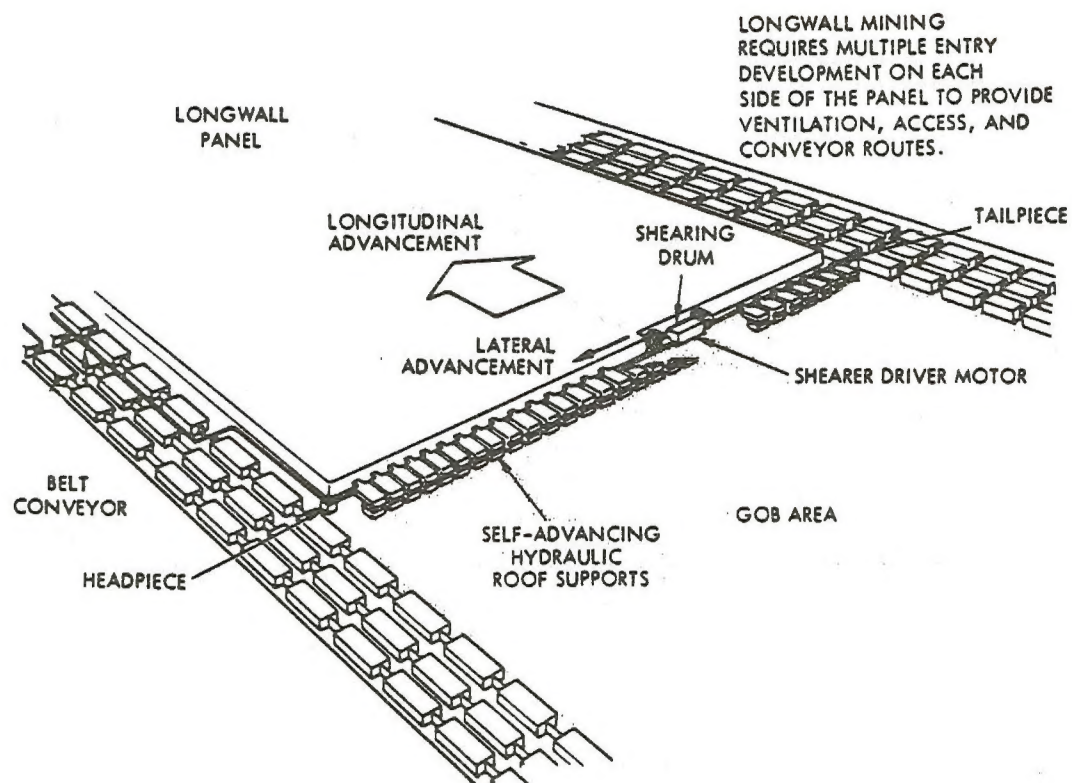
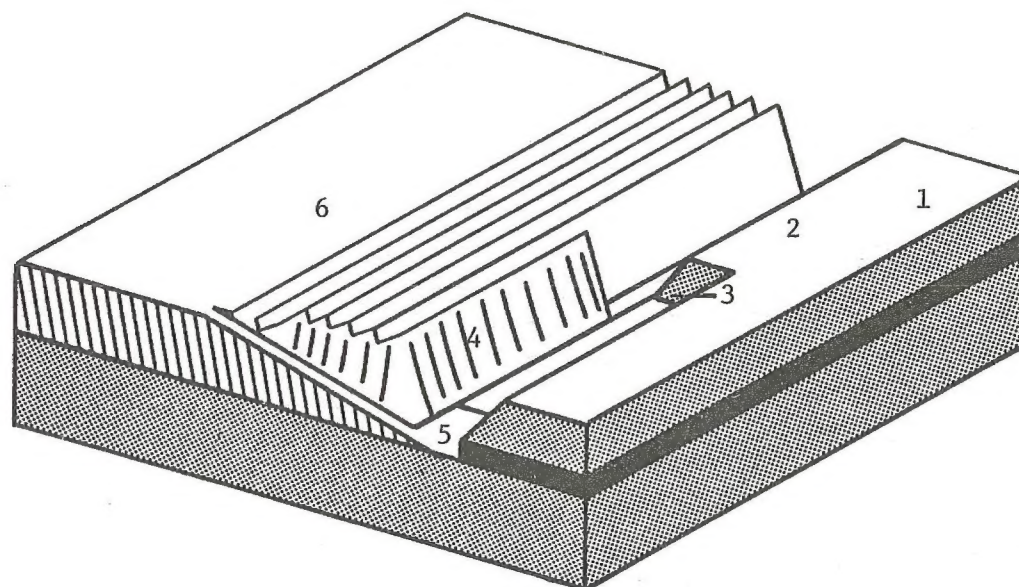


FIGURE C-4
LONGWALL MINING

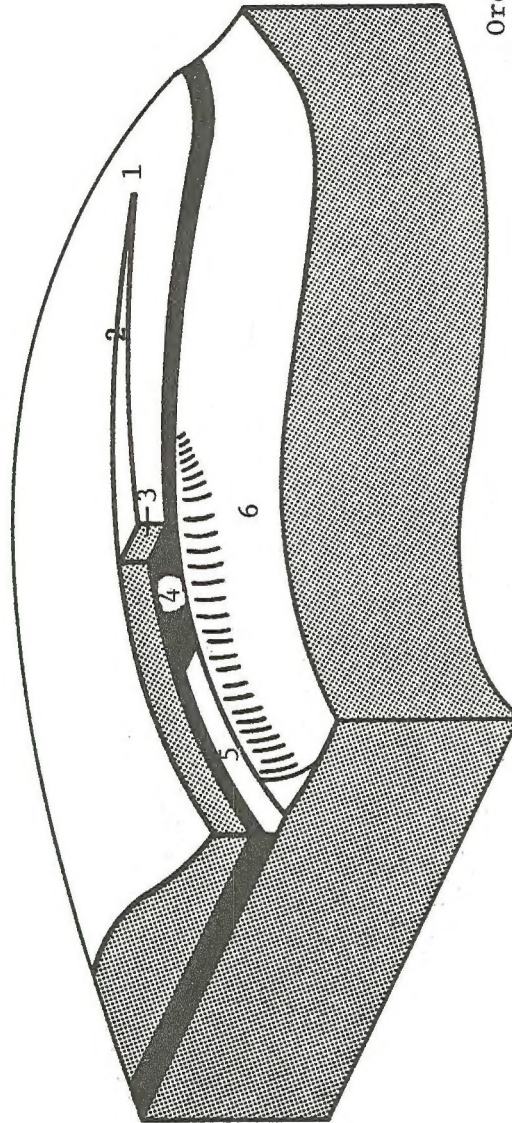


Order in which operations are performed:

- 1 - Topsoil removal
- 2 - Overburden drilling and blasting
- 3 - Overburden removal
- 4 - Coal drilling and blasting
- 5 - Coal loading and hauling
- 6 - Reclamation

FIGURE C-5

AREA STRIPPING WITH DRAGLINES -
HYPOTHETICAL PIT ARRANGEMENT



- Order in which operations are performed:
- 1 - Topsoil removal
 - 2 - Overburden drilling and blasting
 - 3 - Overburden removal
 - 4 - Coal drilling and blasting
 - 5 - Coal loading and hauling
 - 6 - Reclamation

FIGURE C-6
CONTOUR MINING -
HYPOTHETICAL PIT ARRANGEMENT

previous cut from which the coal has been removed. These parallel cuts continue across the coal seam until the thickness of the overburden becomes too great to be removed economically or until the end of the coal seam or property is reached. Figure C-7 depicts a cross-section and plan view of a portion of a strip coal mine. Both single and multiple seams, near the surface, can be mined in this manner.

Overburden removal can be accomplished with almost any kind of earth-moving equipment, but bucket-wheel excavators, draglines, and shovels are the three kinds of equipment used at large area-stripping operations. Bucket-wheel excavators are used extensively in Europe, but in the United States, the dominant machines are draglines and shovels.

This is not strictly a matter of preference, but results from the nature of the overburden material. In the United States much of the overburden contains layers of shale, limestone, or sandstone that must be drilled and blasted before it can be removed. Draglines and shovels are more efficient in these materials than a bucket-wheel excavator. After the overburden is removed, coal is usually drilled and blasted. Then it is loaded into coal haulers with either a shovel or a front-end loader.

Contour stripping is practiced on steep terrain, mostly in the Appalachian Coal Region. The method consists of removing overburden from the coalbed with the first cut at or near the outcrop and proceeding around the hillside. Overburden is stacked along the outer edge of the bench. After the uncovered bed is removed, successive cuts, usually only two or three, are made until the depth of the overburden becomes too great for economic recovery of the coal. Contour mining creates a shelf or bench on the side of the hill. On the inside it is bordered by the highwall, ranging in height from a few feet to more than 100 feet, and on the outer side by a high ridge of spoil. Equipment commonly used for contour stripping is smaller in size and load capacity than that used for area stripping. Dozer and front-end loaders are often used for overburden removal at these operations.

In the eastern United States, auger mining is used on hillside terrain. It requires a surface cut (removal of overburden and a portion of the coal bed) to allow the auger access to the bed. It is often used to recover part of the coal left from underground mining. In the western United States, auger mining is used in conjunction with strip mining. Coal mining by the auger method entails boring horizontal or near horizontal holes in an exposed face of coal and loading the coal removed by the auger. Three choices of auger heads—single, dual or triple—are available to remove up to 90 inches of coal for a distance of over 200 feet. Average depth is about 160 feet. Augering is generally used to supplement recovery at contour or strip mines when the overburden thickness becomes too great to be economically removed. It is also used where the terrain is too steep for overburden removal and recovery by underground methods would be impractical or unsafe.

In open-pit mining, overburden is removed and placed outside the mining area. The pit increases in size and depth as mining progresses, and it is unusual that the overburden, once removed, is ever returned to the pit. Open-pit mining is used extensively for mining ores of copper and iron, and sand and gravel. Its use in coal mining is being tried where numerous

pitching seams lie parallel to each other and outcrop on a relatively flat terrain. The overburden can be removed with either scrapers or shovels loading into trucks.

For quarry-type mining the coalbed typically averages over 60 feet in thickness. It is benched to facilitate its removal. A variation of strip mining of thick coalbeds, it first requires dividing the mine area into 40-acre tracts for example. Overburden is removed from two tracts, away from the outcrop, with shovel and trucks and spoiled (piled) on land toward the outcrop that will be mined later. Thus, eighty acres of spoil will have to be handled twice, but when mining is completed land that did not produce coal will not have been disturbed. When overburden is removed from a third tract, enough of the thick coal seams will have been mined from the first tract to allow spoiling in the first tract. When mining terminates, the mined area will have an appearance similar to that before mining started, but lower in elevation.

Table C-1 shows the number of acres that would be stripped of overburden each year from a coal deposit to expose the required tonnage to be mined. In actual practice, stripping is six months or more ahead of mining. The number of acres disturbed shown in Table C-1 does not include areas impacted by other mining activities such as overburden storage, access roads, utility corridors and the mine plant. These additional disturbed areas could equal that shown in the Table.

C.2.3.2 Coal Beneficiation. Crushing and cleaning of mine-run coal is commonly referred to as beneficiation or preparation. Often crushing and sizing is all that is required, but many coal seams, especially those in eastern and midwestern states, contain enough impurities to necessitate further cleaning. Impurities in coal are innumerable, but those occurring in quantity, such as clay, rock, shale, and pyrite, require removal. Processes vary from simple to complex. The simplest are crushing and screening operations, which remove large pieces of foreign material, and are usually done with a breaker. Beyond this, whether the process is wet or dry, it is commonly referred to as washing. The dry washing method has advanced from merely blowing the dust from coal to using pulsating air to separate the coal and largely eliminate the need for close screen sizing. Presently, almost all air-cleaning machines depend on pulsating air. Wet washing of coal is accomplished by floating the coal and sinking the impurities in water. Wet washing starts with breaking and screening the coal to remove the large, hard pieces of impurities. Additional cleaning depends upon the amount, size, and type of impurity and how it is dispersed in the coal, and how the coal is to be used. Equipment can include any or all of the following: jigs, screens, landers, heavy-medium cyclones, tricone separators, concentrating tables, froth flotation, cells, filters, and driers.

Whether the coal to be supplied a given customer is to undergo preparation processing at the mine plant depends upon the customer's needs. Customers using best available control technology (BACT) for emissions can probably use run-of-mine coal directly. Other customers may already have preparation facilities to size the coal to their specific needs.

C.2.4 Land Reclamation

The term reclamation is used here to mean any process for rehabilitating land disturbed by coal mining. The term

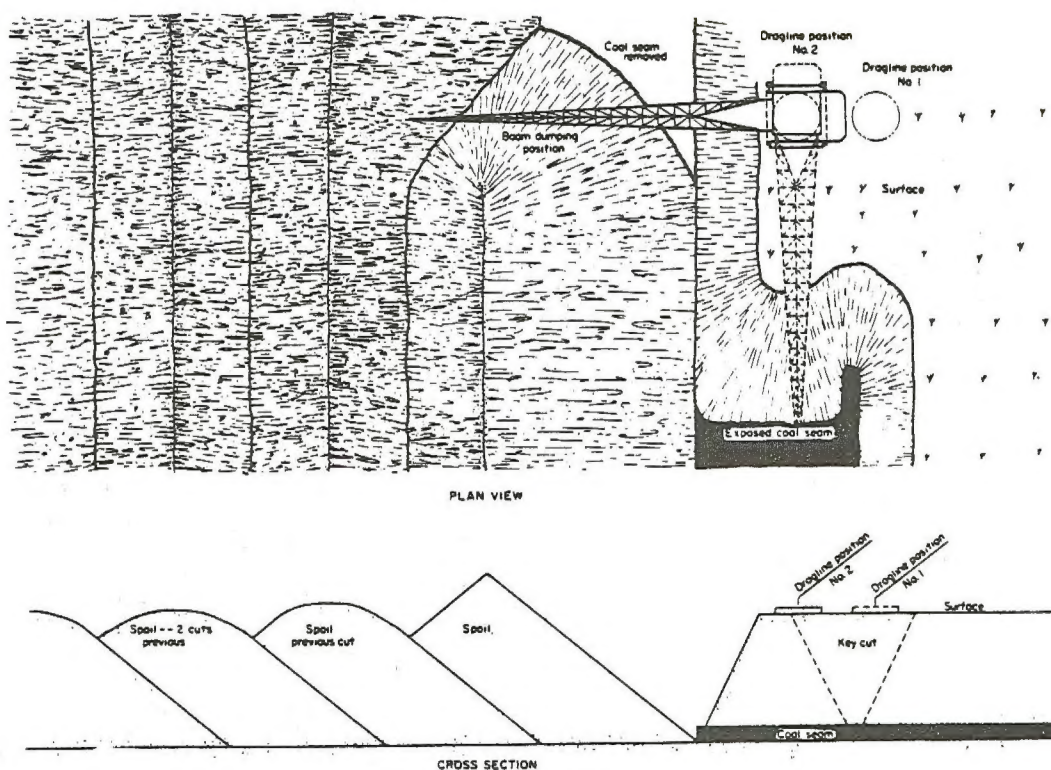


FIGURE C-7

CROSS-SECTION AND PLAN VIEW
OF A PORTION OF A STRIP COAL MINE

TABLE C-1

RELATIONSHIP OF COAL THICKNESS TO PRODUCTION

SEAM THICKNESS IN FEET	TONS OF COAL* PER ACRE OF SEAM	ANNUAL PRODUCTION	NO. OF ACRES STRIPPED/YEAR @ 90% RECOVERY
5	8,750	500,000	63.49
		1,000,000	126.98
		2,000,000	253.97
		5,000,000	317.46
10	17,500	500,000	31.75
		1,000,000	63.49
		2,000,000	126.98
		5,000,000	317.46
15	26,250	500,000	21.16
		1,000,000	42.33
		2,000,000	84.66
		5,000,000	211.64
20	35,000	500,000	15.87
		1,000,000	31.75
		2,000,000	63.49
		5,000,000	158.73
20	35,000	500,000	10.58
		1,000,000	21.16
		2,000,000	42.33
		5,000,000	105.82
50	87,500	500,000	6.35
		1,000,000	12.70
		2,000,000	25.40
		5,000,000	63.49
75	131,250	500,000	4.23
		1,000,000	8.46
		2,000,000	16.93
		5,000,000	42.33

*Calculated on the basis of 1,750 tons per acre foot.

refers to returning the disturbed land to a condition and/or productivity equal to or higher than prior to mining. Reclamation consists basically in making a mine site safe, acceptable in appearance, and available for other uses before mine abandonment.

The goals of reclamation related to coal development are different from those of restoration, which can entail, for example, the conversion of waste, desert, marshy or submerged land into farmland. Reclamation is intended to bring the land back to its former values, sometimes including a desert or arid situation.

The esthetic qualities of coal-mined areas will be changed most drastically in areas with steep topography and 6 inches or less of annual precipitation. Before commitment of an area to coal mining, other developments proposed for adjoining or nearby areas must also be considered. Coal mining may disturb relatively small areas at any one time if rehabilitation is done as soon as possible. However, in combination with environmental impacts from other sources, the added impacts from coal mining could be more serious than if they were the only ones on the landscape. The precise nature of impacts can be determined only when a specific mining proposal is examined. That step is taken by interagency teams making environmental analysis in connection with applications for prospecting and mining plans, in developing stipulations to be incorporated in coal leases, in administering coal leases, in directing rehabilitation measures, and in assessing any unmitigated impacts that remain after all requirements have been met and leases are terminated.

Reclamation consists of 4 phases: planning, topsoil/overburden segregation, backfilling, and revegetation. The planning phase begins prior to mining and continues throughout the mining cycle. This phase mainly involves: 1) site mapping, 2) identification of the probable effects of mining before mining begins, 3) development of the reclamation plan including mitigating measures to be followed during all mining activities, 4) preparation of periodic environmental reports, 5) bond and permit fee related activities, 6) supervision of the reclamation work, 7) engineering and surveying for environmental protection, 8) water quality monitoring, 9) dust control, and 10) consultation with outside experts.

Topsoil/overburden segregation and backfilling usually include: 1) removal of vegetative cover when its removal is necessary for topsoil salvage, 2) removing and stockpiling topsoil and overburden separately, 3) backfilling and grading cuts with original overburden, and 4) replacing topsoil [5,6].

Techniques used in the topsoil/overburden segregation and backfilling phases differ according to the type of mining method used. In the Appalachian Coal Region where contour mining is dominant, two mining approaches, box-cut and truck haulback, have been implemented to integrate the topsoil/overburden segregation and backfilling reclamation phases into the mining cycle [7]. Such integration has increased the efficiency of the overall mining process by reducing backfill requirements after overburden removal and spoil placement.

Area strip mining is dominant in most non-Appalachian coal regions. Separation of topsoil from overburden is accomplished by draglines, bucket wheel excavators, and scrapers [8]. In areas with shallow coal seams, the overburden

can be removed with a single effort and is referred to as the full-cut technique. In areas with thick overburden, the bench technique is used to rotate overburden from an active cut to a previous cut in its natural sequence. Topsoil is usually applied and graded by draglines and dozers [8,9,10]. Surface configuration methods include: 1) terracing, 2) pitting, 3) ditching, 4) listering, 5) deep chiseling, and 6) discing.

The revegetation phase usually consists of the following in each coal region: 1) soil preparation (discing, mulching, fertilizing, etc.), 2) seeding and/or planting, 3) reseeding and/or replanting, and 4) irrigation [5,6]. The methods used in each of the four categories differ substantially in various coal regions due mainly to different topsoil characteristics and environmental conditions.

Most of the Federal coal is in the Rocky Mountain and Northern Great Plains Coal Provinces. The dominant surface uses of Federal land in those two provinces are for livestock forage production, wildlife habitat, watersheds, wide-ranging recreational activities, and for timber production. In those provinces, surface mining on Federal lands will occur mainly in nonforested areas. On the other hand, forested terrain is generally such that if coal is mined, it will be by underground methods. Consequently, except for areas disturbed at mine portals and plant sites, the principal effect on existing forests will be from subsidence.

In the Fort Union, Powder River, and Denver-Raton Mesa Coal Regions, revegetation limiting factors are: 1) the amount and distribution of precipitation, 2) soil nutrient concentrations, 3) soil alkalinity and salinity levels, and 4) the suitability and availability of different plant species [11,12]. Most soils are deficient in phosphorus and nitrogen but receive in excess of 12 inches of precipitation annually. Erosion is a serious problem in some areas as is excessive aggregation in others.

Surface soil replacement is necessary for successful vegetation reestablishment [11]. Spoils are graded to short lengths of gentle-to-moderate slopes and the highest site-production overburden is placed near the surface. Tillage is accomplished by conventional agricultural techniques. Fertilizers are applied for best vegetation success. Gypsum is added to saline soils and irrigation is sometimes necessary during erratic climatic years. Most areas are seeded to grass and legume mixtures using established farming practices [9]. Management measures are similar to those described for the San Juan Coal River Region below.

In the San Juan Coal River Region, the major limiting factor to revegetation is water [13]. Precipitation averages 6 inches annually and evapotranspiration is much higher [14]. Another factor is a thin topsoil layer overlying an impermeable overburden which causes flash flooding and wind erosion. Alkalinity values of the topsoil approach a pH of 9.0 and large amounts of sodium are present.

Irrigation is essential during the first year of revegetation and may be necessary in subsequent years of extraordinarily low rainfall [15]. Currently, the most effective method is to simulate 12-14 inches of effective annual precipitation with sprinkler irrigation the first growing season followed with spring irrigation the next growing season [13]. In the Black Mesa Field, irrigation is not normally necessary. Species used for revegetation are selected on the basis of the future land use which is usually grazing [13].

Revegetation limiting factors in the Uinta-Southwestern Utah and Green River-Hams Fork Coal Regions are similar to those in the San Juan River Coal Region. Revegetation is accomplished by: 1) spoils segregation; 2) addition of topsoil (4-6 inches) selected for nutrient status and moisture capacity; 3) surface manipulation to reduce the rate of surface flow; 4) broad mixture seeding of adapted species; 5) precipitation conservation using slow drainage design, moisture retaining subsoil, and mulches; and 6) gradient reductions [16].

In the Eastern and Western Interior Coal Regions, the primary limiting factors to revegetation are topsoils with low organic matter, low pH, low nitrogen, and poor tilth [10,17]. These problems are mitigated by the use of fertilizers, lime and leguminous plant species. Conventional farming methods and aerial broadcasting are used in reseeding [10].

Topsoil is not salvaged in the Texas Coal Region because plant nutrients have been leached to subsurface material [5]. Therefore, the latter is used as the growth medium. Bulldozers and scrapers are used to grade soil into gently rolling flatland to be used for row crops, hay meadows, or pasture. Spoil is usually revegetated with Bermuda grass. Seeding, disking, and fertilizing occur in the spring. The second and consecutive years are used for hay, pasture, or both.

A number of reclamation techniques have been tested in recent years which will allow more efficient and economic reclamation. A lateral groove technique allows efficient terracing of steep slopes in areas of rugged terrain such as the Appalachians [18]. This method allows rapid plant establishment on easily erodible slopes by increasing soil moisture and producing a "banding" effect of seed and fertilizer.

Dryland planting innovations in Montana include: 1) condensation traps, 2) supplemental rooting, 3) tubelings, and 4) use of plants which are tolerant to drought, alkalinity, and salty soil [19]. Surface manipulation techniques such as deep chiseling, gouging, and dozer basins have increased soil moisture and plant establishment.

A precipitation management method has been successfully used [20] which will aid revegetation in arid and semi-arid regions. This technique involves concentration of precipitation runoff in parallel contours which increases soil moisture amount and duration of availability to plant roots. In one test, most perennials survived a 1 inch rainfall year (one runoff event).

C.3 FUTURE USES OF COAL

Although coal comprises 90 percent of the country's fossil fuel reserve, only 18 percent of the national energy needs are met with coal. A cornerstone of the National Energy Plan is to correct this imbalance between reserves and consumption. In the near term, conversion of existing facilities in industry to coal from oil and natural gas is encouraged, and construction of new facilities that burn oil or gas prohibited. Expanding future use of coal will depend largely on the successful commercialization of new technologies that convert coal to clean fuels and that permit coal to be burned in an environmentally acceptable manner. Processes are being developed under Federal sponsorship to convert coal into substitutes for oil and natural gas (such as crude oil, fuel oil and distillates; chemical feedstocks; and high, low and

intermediate Btu gas) as well as to permit increased use of coal by direct combustion (such as in industrial boilers and process heaters, and as primary fuel for electric power generation).

Coal gasification processes have been commercially available for many years. However, the processes are costly, and in many cases limited in the kinds and sizes of coal that can be processed [21].

C.3.1 Coal Gasification

Coal gasification is a process of chemical transformation of solid coal into gas which is essentially methane, carbon monoxide or free hydrogen and virtually free of sulfur. Commercial coal gasification processes in use today outside the United States include the Lurgi, Koppers-Totzek, and Winkler processes. Presently, three types of coal gasification plants are being proposed: low Btu gasifiers for industrial and utility boiler fuels; intermediate-Btu gasifiers producing feedstock for manufacture of liquid fuels; and high-Btu or synthetic natural gas (SNG) to support declining pipeline quality gas supplies.

Processes currently being developed under the High-Btu Gasification Subprogram of the Department of Energy include: Bi-Gas, Hygas, CO₂ acceptor, Self-Agglomerating Ash, Synthane, and Hydrane. Figure C-8 is a flow chart for the CO₂ Acceptor Process.

Processes currently being investigated under the Low-Btu Gasification Subprogram of the Department of Energy include: Fixed Bed (Stirred and Slagging), Fluid Bed (Two Stage and Three Stage), Entrained Bed Atmospheric, Combined Cycle, and Molten Salt Pressurized. Figure C-9 is a flow chart of the Fluid Bed, Three Stage Process.

C.3.2 Coal Liquefaction

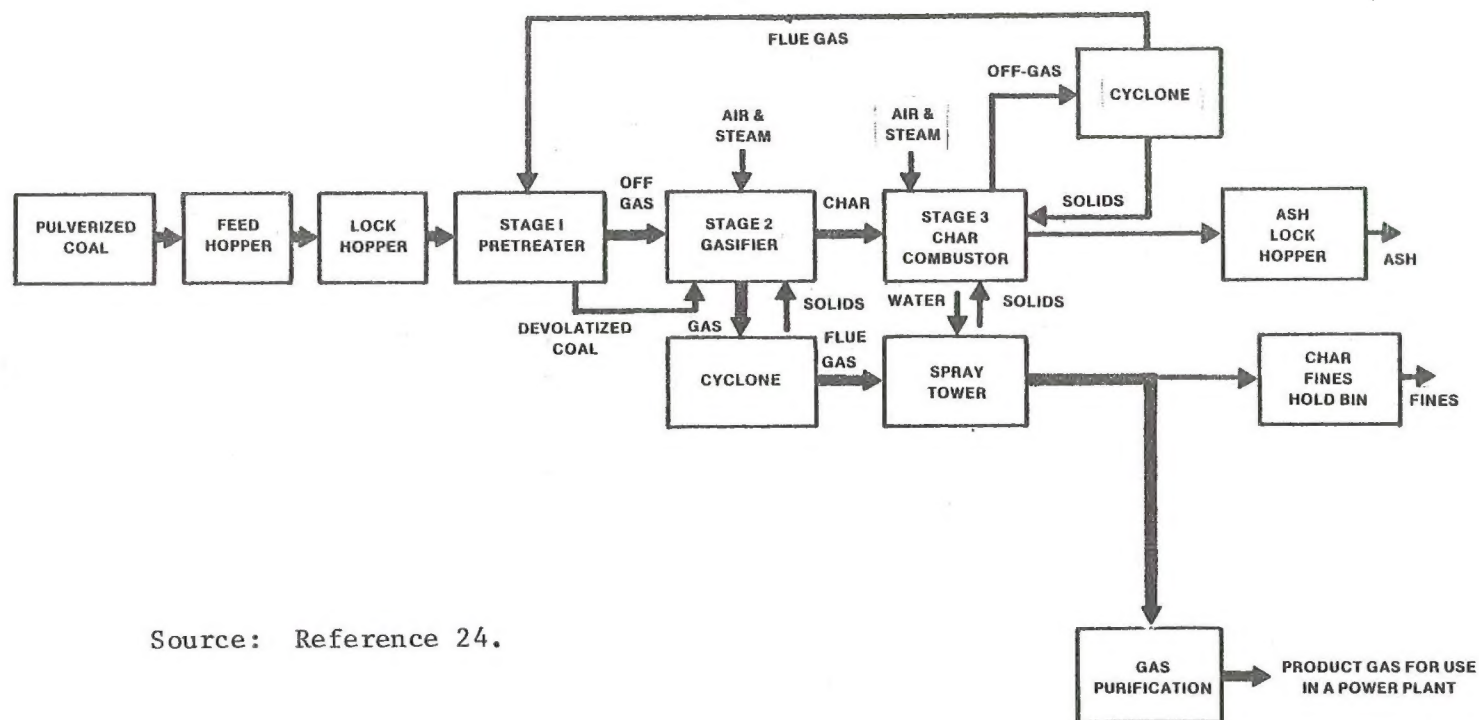
Coal liquefaction is the conversion of solid coal to a liquid; this involves hydrogenation to depolymerize the coal molecules to simpler molecules. The products derived from coal liquefaction could compete with petroleum-refined products in two markets: first, as a low-ash, low-sulfur boiler fuel suitable for clean electric power generation; second, as a substitute for high-grade fuels such as gasoline, heating oil, and chemical feedstock. Processes currently being investigated under the Liquefaction Program of the Department of Energy include: H-coal, Synthoil, Solvent Refined Coal, Donar Solvent, Entrained Pyrolysis, and Flash Liquefaction. Figure C-10 is a flow chart of the H-Coal Process.

C.3.3 Direct Combustion

Direct combustion processes are intended to develop fluidized bed combustion systems capable of directly burning high-sulfur coals of all ranks and quality in an efficiently and environmentally acceptable manner. These processes will permit increased utilization of coal by direct combustion in utility, industrial/institutional boilers, for heat and electric power generation. Processes currently being investigated are Fluidized Bed Boilers and Fluidized Bed Combustion. Figure C-11 is a flow chart for the latter process.

FIGURE C-8

HIGH-BTU GASIFICATION: CARBON DIOXIDE ACCEPTOR



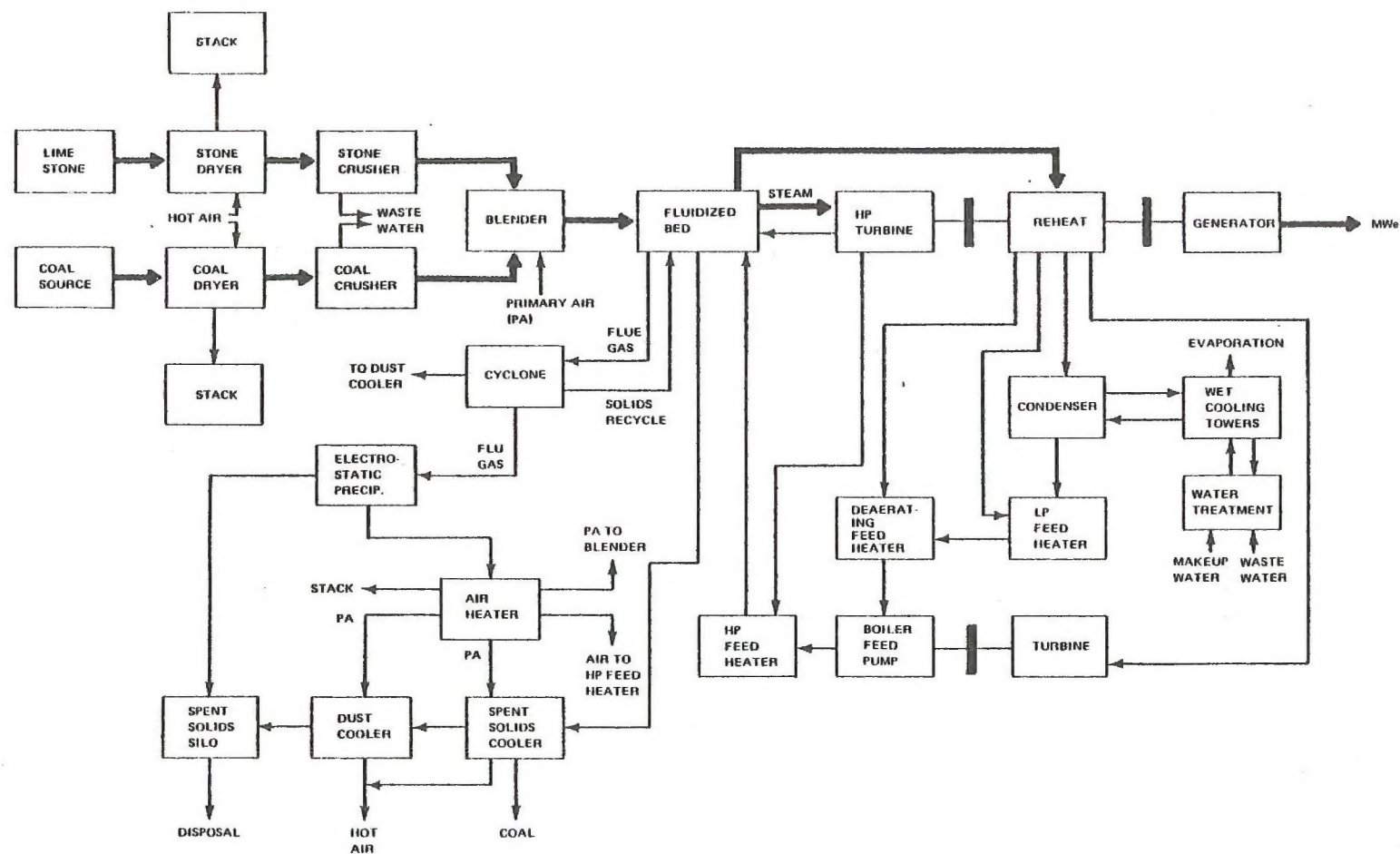
Source: Reference 24.

FIGURE C-9
FLUIDIZED-BED GASIFICATION
BCR THREE-STAGE PRESSURIZED PROCESS

Source: Reference 25.

FIGURE C-10

LIQUEFACTION-DIRECT HYDROGENATION H-COAL PROCESS



Source: Reference 26.

FIGURE C-11

ADVANCED STEAM CYCLE ATMOSPHERIC FLUIDIZED
BED COMBUSTION (FBC)

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APPENDIX D

ECOLOGICAL DATA

TABLE D-1
ESTIMATED REGIONAL CARRYING CAPACITIES
AND PRIMARY PRODUCTIVITIES

REGION	CARRYING CAPACITIES OF OCCUPIED HABITAT	PRODUCTIVITIES PER ACRE/YEAR
Appalachian	2.19 acres/animal unit 10 small mammals/acre 1 white-tailed deer/15 acres (high density areas) 1 white-tailed deer/200 acres (low density areas) 3.5 songbirds/acre 1 gamebird/4 acres 1 large predator/500 acres 2-3 reptiles-amphibians/ acre 125-130 pounds fish/acre- foot reservoir	Hardwood forest 8.9 tons Wetlands 17.8 tons Corn 79.9 bu Soybeans 26.8 bu Hay 1.9 tons Cotton 380 pounds Wheat 38.5 bu Oats 48.3 bu
Eastern Interior	1.7 acres/animal unit 10 small mammals/acre 1 white-tailed deer/166 acres 3.5 songbirds/acre 1 gamebird/5 acres 1 large predator/500 acres 2-3 reptiles-amphibians/ acre 125-150 pounds fish/acre- foot reservoir	Hardwood forest 8.9 tons Prairie 5.8 tons Wetlands 17.8 tons Corn 100.7 bu Soybeans 32.5 bu Hay 1.9 tons Wheat 38.6 bu
Western Interior	2.6 acres/animal unit 10 small mammals/acre 1 white-tailed deer/33 acres 3.5 songbirds/acre 1 gamebird/5 acres 1 large predator/500 acres 2-3 reptiles-amphibians/ acre 400 pounds fish/acre-foot reservoir	Hardwood forest 8.9 tons Prairie 5.8 tons Wetlands 17.8 tons Corn 84.6 bu Soybeans 25.6 bu Hay 2.0 tons Wheat 29.1 bu Cotton 390 pounds

TABLE D-1 (CONTINUED)

REGION	CARRYING CAPACITIES OF OCCUPIED HABITAT	PRODUCTIVITIES PER ACRE/YEAR
Texas	6.6 acres/animal unit	Hardwood-pine forest 7.1 tons
	10 small mammals/acre	Prairie 5.8 tons
	1 white-tailed deer/ 16 acres	Wetlands 17.8 tons
	3.5 songbirds/acre	Hay 2.3 tons
	1 gamebird/5 acres	Wheat 23.3 tons
	1 large predator/500 acres	Cotton 353 pounds
	3-4 reptiles-amphibians/ acre	Soybeans 23.6 bu
	125-150 pounds fish/acre- foot reservoir	
Powder River	15.5 acres/animal unit	Hardwood forest 5.8 tons
	6-10 small mammals/acre	Montane evergreen forest 8.0 tons
	1 antelope/ 166 acres	Sagebrush steppe 1.8 tons
	1 white-tailed deer/33 acres	Prairie 6.7 tons
	1 mule deer/ 200 acres	Floodplains 5.4 tons
	1 songbird/acre	Hay 1.7 tons
	1 gamebird/30 acres	Wheat 26.2 bu
	1 large predator/500 acres	Oats 43.0 bu
	2.3 reptiles/amphibians	Sugarbeets 19.5 tons
	55 pounds trout/acre- foot stream	
	250 pounds fish/acre- foot reservoir	
Green River-Hams Fork	9.3 acres/animal unit	Sagebrush steppe 1.8 tons
	50-60 small mammals/acre	Desert steppe 2.2 tons
	1 antelope/66 acres winter range	Pinyon-Juniper 5.4 tons
		Montane evergreen forest 5.0 tons
	1 antelope/250 acres summer range	Corn 95.8 bu

TABLE D-1 (CONTINUED)

REGION	CARRYING CAPACITIES OF OCCUPIED HABITAT	PRODUCTIVITIES PER ACRE/YEAR
Green River -Hams Fork (Continued)	1 mule deer or elk/125 acres 1 moose/250 acres 2.5 songbird/acre 1 large predator/500 acres 4.5 reptiles-amphibian/acre 55 pounds trout/acre-foot stream 250 pounds fish/acre-foot reservoir	Hay 2.2 tons Wheat 23.2 bu Oats 42.0 bu Sugarbeets 18.4 tons
Fort Union	8.2 acres/animal unit 8-10 small mammals/acre 1 antelope/125 acres 1 white-tailed deer/33 acres 1 mule deer/200 acres 1 songbird/acre 1 gamebird/7 acres 1 large predator/3200 acres 250 pounds fish/acre- foot reservoir	Prairie 6.7 tons Floodplains 5.4 tons Montane evergreen forest 8.0 tons Hardwood forest 5.8 tons Soybeans 17.3 bu Hay 1.4 tons Wheat 24.6 bu Sugarbeets 19.3 tons
San Juan River	11.04 acres/animal unit 4-6 small mammals/acre 1 bighorn sheep/10 acres 1 mule deer/330 acres 2.5 songbirds/acre 1 gamebird/5 acres 1 large predator/330 acres 2.6 reptiles-amphibians/ acre 250 pounds fish/acre-foot reservoir	Sagebrush steppe 1.8 tons Grasslands 4.5 tons Montane evergreen forest 8.0 tons Corn 96.6 bu Hay 3.6 tons Wheat 35.8 bu Cotton 720.5 pounds Sugarbeets 17.8 tons

TABLE D-1 (CONCLUDED)

REGION	CARRYING CAPACITIES OF OCCUPIED HABITAT	PRODUCTIVITIES PER ACRE/YEAR
Uinta -Southwestern Utah	8.3 acres/animal unit	Sagebrush steppe 1.8 tons
	4-6 small mammals/acre	Mountain hardwood 5.8 tons
	1 mule deer/100 acres	Montane evergreen forest 8.0 tons
	1 elk /100 acres	Corn 95.8 bu
	2.5 songbirds/acre	Hay 2.5 tons
	1 gamebird/5 acres	Wheat 23.3 bu
	1 large predator/500 acres	Sugarbeets 17.8 tons
	2.6 reptiles-amphibians/ acre	
	55 pounds trout/acre-foot stream	
	250 pounds fish/acre-foot reservoir	
Denver-Raton Mesa	1.6 acres/animal unit	Prairie 7.6 tons
	8-10 small mammals/acre	Pinyon -juniper forest 5.9 tons
	1 mule deer/100 acres	Montane evergreen forest. 8.0 tons
	1 antelope/100 acre	Sagebrush steppe 1.8 tons
	2.5 songbirds/acre	Corn 100.8 bu
	1 gamebird /acre	Hay 2.9 tons
	1 large predator/500 acres	Wheat 23.4 bu
	2.6 reptiles-amphibians/ acre	Cotton 380 pounds
	55 pounds trout/acre- foot stream	Sugarbeets 18.6 tons
	250 pounds fish/acre- foot reservoir	

Sources: Reference Numbers 1, 2, 3, 4, 5, 6, and 7.

TABLE D-2
FEDERALLY PROTECTED SPECIES OF THE FEDERAL COAL REGIONS

Regio..	Fish	Reptiles and Amphibians	Birds	Mammals	Invertebrates	Plants
Appalachian	tercross darter (c) (1)		Bachman's warbler (E) (2) Red cockaded wood- pecker (E) (1) Kirtland's warbler (E) (2) Southern Bald Eagle (E) (1/2) Peregrine falcon (E) (2)	Gray bat (E) (1) Indiana bat (E) (1) Eastern cougar (E) (1)	Birdwing pearly mussel (E) (1) Green-blossom pearly mussel (E) (1) Tuberculed-blossom pearly mussel (E) (1) Fine-rayed pigtoe pear- ly mussel (E) (1) Shiny pigtoe pearly mus- sel (E) (1) Pink mucket pearly mus- sel (E) (1) Alabama lamp pearly mus- sel (E) (1) White warty-back pearly mussel (E) (1) Rough pigtoe pearly mus- sel (E) (1) Cumberland monkeyface pearly mussel (E) (1) Appalachian monkey face pearly mussel (E) (1) Pale lilliput pearly mussel (E) (1) Cumberland bean pearly mussel (E) (1) Yellow-blossom pearly mussel (E) (1) Turgid-blossom pearly mussel (E) (1) Dromedary pearly mussel (E) (1) Orange-footed pimple back mussel (E) (1)	
Eastern Interior			Red cockaded wood- pecker (E) (1) Kirtland's warbler (E) (2) Bald eagle (E) (2) Peregrine falcon (E) (2)	Gray bat (E) (1) Indiana bat (E) (1)	Tuberculated blossom pearly mussel (E) (1) Sampson's pearly mussel (E) (1)	

TABLE D-2 (CONT)

Regions	Fish	Reptiles and Amphibians	Birds	Mammals	Invertebrates	Plants
Western Interior			Red cockaded wood- pecker (E) (1) Southern bald eagle (E) (2) Whooping Crane (E) (2) Peregrine falcon (E) (2) Eskimo curlew (E) (2) Backman's warbler (E) (2)	Indiana bat (E) (1) Gray bat (E) (1) Red wolf (E) (1)		Northern wild monkshood (T) (1)
Texas	Fountain darter (E) (1)	Texas blind sala- mander (E) (1) American Alligator (E) (1) Houston toad (E) (1)	Attwater's greater prairie chicken (E) (1) Ivory billed wood- pecker (E) Whooping crane (E) (2) Mexican Duck (E) (2) Red cockaded wood- pecker (E) (1) Bald eagle (E) (2) Peregrine falcon (E) (2)	Red wolf (E) (1)		Texas wild rice (E) (1)
Powder River			Whooping crane (E) (2) (2) Bald eagle (E) (2) American Peregrine falcon (E) (2)	Black-footed ferret (E) (1) Northern Rocky Moun- tain wolf (E) (1) Grizzly bear (T) (1)		
Green River - Hams Fork	Greenback cutthroat trout (E) (1) Humpback chub (E) (1) Colorado squawfish (E) (1) Kendal warm springs dace (E) (1)		Whooping crane (E) (2) Bald eagle (E) (2) American peregrine falcon (E) (2)	Utah prairie dog (E) (1) Northern Rocky Moun- tain Wolf (E) (1) Black-footed ferret (E) (1)		

TABLE D-2 (CONCLUDED)

Region	Fish	Reptiles and Amphibians	Birds	Mammals	Invertebrates	Plants
Fort Union			Whooping crane (E) (2) Bald eagle (E) (2) Tule white-fronted goose (T) (2) Peregrine falcon (E) (2)	Black-footed ferret (E) (1) Northern Rocky Moun- tain Wolf (E) (1) Northern kit fox* (E)		
San Juan River	Apache trout (T) (1)		Whooping crane (E) (2) Mexican Duck (E) (2) Southern bald eagle (E) (2) Peregrine falcon (E) (2) Thick-billed parrot (E) (1)	Gray wolf (E) (1)		
Uinta- Southwestern Utah	Woundfin (E) (1) Humpback chub (E) (1) Colorado squaw fish (E) (1)		Yuma clapper rail (E) (2) Whooping crane (E) (2) Bald eagle (E) (2) Peregrine falcon (E) (2)	Utah prairie dog (E) (1) Black-footed ferret (E) (1)		Rydberg milk vetch (T) (1)
Denver-Raton Mesa	Greenback cutthroat trout (E) (1)		Southern bald eagle (E) (2) Peregrine falcon (E) (2) Whooping crane (E) (2)	Black-footed ferret (E) (1)		

* Probably not a resident of study area, however, one was trapped in slope County in 1970. (Reference 7)

Sources: Reference Numbers 7, 8, 9, and 10.

KEY

(E) Endangered
(T) Threatened
(1) Permanent resident
(2) Migratory species

TABLE D-3
POTENTIAL THREATS TO ENDANGERED SPECIES OF COAL REGIONS

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
<u>FISHES</u>				
Woundfin	<u>Plagopterus argentissimus</u>	Virgin River below Hurricane, Utah	swift rivers	reservoirs
Greenback cutthroat trout	<u>Salmo clarki stomias</u>	Blackhollow Creek, Cache la Poudre River, few possible streams in Boulder & Larimer Counties, Colorado	fresh, cold streams & rivers	reservoirs
Arizona (apache) trout	<u>Salmo apache</u>	Arizona	streams	reservoirs
Humpback chub	<u>Gila cypha</u>	Green & Colorado Rivers, from Grand Canyon area northward to vicinity of Flaming Gorge Dam on Utah-Wyoming border	flowing streams & rivers	reservoirs
Colorado squawfish	<u>Ptychocheilus lucius</u>	Middle and lower Green River, main Colorado River above Lake Powell, and Salt River; spawning in Yampa and Green Rivers	turbid, swift warm rivers	reservoirs
Kendal Warm Springs dace	<u>Rhinichthys osculus thermalis</u>	Kendall Warm Springs, tributary to the Green River in Wyoming	warm springs fed streams	reservoirs
Fountain darter	<u>Etheostoma fonticola</u>	Comal & San Marcos Springs in Hays and Comal Counties Texas	spring out-flow	strip mining
Watercress darter	<u>Etheostoma nuchale</u>	Glen Springs at Bessemer, Jefferson County, Alabama (Black Warrior River drainage)	springs with watercress	highways, pipelines
<u>HERPILES</u>				
Texas blind salamander	<u>Typhlomolge rathbuni</u>	Hays County Texas	deep wells, underground streams	probably none
Houston toad	<u>Bufo houstonensis</u>	Southcentral Texas	loblolly pine forests	strip mining
American Alligator	<u>Alligator mississippiensis</u>	North Carolina, South to Texas, Florida, Louisiana, Georgia, Arkansas, Southeast Oklahoma	Fresh wetlands, salty estuaries	habitat loss
<u>BIRDS</u>				
Eskimo curlew	<u>Numenius borealis</u>	Alaska, migratory through Central U.S.	grasslands and tundra	habitat loss

TABLE D-3 (CONT.)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Black-footed ferret	<u>Mustela nigripes</u>	Western United States and Canada	shortgrass prairie	strip mining
Utah prairie dog	<u>Cynomys parvidens</u>	Utah	grassland & cropland	strip mining
Eastern cougar	<u>Felis concolor cougar</u>	Eastern United States (Canada to Carolinas)	remote woodlands and mountains	community expansion
Red wolf	<u>Canis rufus</u>	Texas, Louisiana (Gulf regions)	coastal prairie marshes, swamp-lands	community expansion
Mexican wolf	<u>Canis lupus baileyi</u>	Arizona, Texas and Mexico	remote arid	community expansion
Gray wolf	<u>Canis lupus monstrabilis</u>	Texas, New Mexico, Mexico	remote arid prairies	community expansion
Northern Rocky Mountain Wolf	<u>Canis lupus irremotus</u>	Wyoming, Montana, South Dakota (Black Hills), Idaho, Oregon and Washington	remote mountain regions & open lands & forests	community expansion
<u>CLAMS</u>				
Birdwing pearly mussel	<u>Conradilla caelata</u>	Powell & Clinch Rivers in Virginia and Tennessee; Duck River in Tennessee	river	reservoirs
Dromedary pearly mussel	<u>Dromus dromas</u>	Powell & Clinch Rivers in Virginia and Tennessee	river	reservoirs
Green-blossom pearly mussel	<u>Epioblasma torulosa torulosa</u>	Clinch River in Virginia and Tennessee	river	reservoirs
Tuberculed-blossom pearly mussel	<u>Epioblasma torulosa torulosa</u>	Lower Ohio River in Kentucky and Illinois, Nolichucky River in Tennessee and Kanawha River in West Virginia	river	acid drainage, reservoirs
Fine-rayed pigtoe pearly mussel	<u>Fusconaia cuneolus</u>	Clinch River in Virginia and Tennessee, Powell River in Virginia and Tennessee, and Paint Rock River in northern Alabama	river	reservoirs
Shiny pigtoe pearly mussel	<u>Fusconaia edgariana</u>	Powell and Clinch Rivers in Virginia and Tennessee, Paint Rock River in Alabama and Holston River in Virginia	river	reservoirs

TABLE D-3 (CONT.)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Yuma clapper rail	<u><i>Rallus lonirostris yumanensis</i></u>	lower Colorado River; California, Arizona	marshes and sloughs	reservoirs
Whooping crane	<u><i>Grus americana</i></u>	winters on Gulf Coast, Texas; migrates through centralwestern U.S. from Canada to Texas	wetlands, coast, grain farmlands	probably none
Attwater's greater	<u><i>Tympanuchus cupido attwateri</i></u>	coastal prairie counties, Texas (primarily Refugio and Colorado Counties)	prairie, grasslands	strip mining
Arctic peregrine falcon	<u><i>Falco peregrinus tundrius</i></u>	Migrates through eastern and middle North America to Gulf	breeds in treeless tundra; migrates along coasts and waterways, feeds in marshes	habitat and wetland removal
American peregrine	<u><i>Falco peregrinus anatum</i></u>	breeds Alaska south to Baja Calif., Arizona to Rocky Mts. (most western states)	coniferous forests and wetlands and along rivers	habitat and wetland removal
Southern bald eagle	<u><i>Haliaeetus l. leucocephalus</i></u>	Atlantic & Gulf coasts, resident of Florida, may be found all over U.S. wandering	wetlands, cliffs, forests, estuaries, freshwater lakes	transmission lines, habitat removal
Mexican duck	<u><i>Anas diazi</i></u>	Arizona, New Mexico, Texas and Mexico	shallow ponds, wetlands	reservoirs
Red-cockaded woodpecker	<u><i>Dendrocopos borealis</i></u>	Oklahoma, Arkansas, Kentucky, Virginia-South to Gulf of Florida	mature pine forests	habitat removal
Ivory-billed woodpecker	<u><i>Campephilus p. principalis</i></u>	Texas, Louisiana	mature hardwoods	habitat removal
Bachman's warbler	<u><i>Vermivora backmanii</i></u>	Virginia, South Carolina, Alabama	swamp forests bottomlands	habitat removal
Thick-billed parrot	<u><i>Rhynchopsitta pachyrhyncha</i></u>	Arizona & New Mexico	mountains	probably none
Kirtland's warbler	<u><i>Dendroica kirtlandii</i></u>	Breeding area-Lower Michigan, migrates south to Bahamas	Jack pines brushy undergrowth	probably none
<u>MAMMALS</u>				
Gray bat	<u><i>Myotis grisescens</i></u>	Central, Southeastern, Midwestern, and Eastern states	limestone caves	mining
Indiana bat	<u><i>Myotis sodalis</i></u>	Central and southeastern states	limestone	mining

TABLE D-3 (CONCLUDED)

Common Name	Scientific Name	Distribution	Habitat	Most Serious Threat
Pink mucket pearly mussel	<u>Lampsilis orbiculata orbiculata</u>	Green River, Kentucky Kanawha River in West Virginia, Tennessee River (Tennessee and Alabama); Muskingum River, Ohio	river river	acid drainage, reservoirs
Alabama lamp pearly mussel	<u>Lampsilis virescens</u>	Paint Rock River System in Alabama	river	reservoirs
White warty-back pearly mussel	<u>Plethobasis cicatricosus</u>	Tennessee River in Tennessee and Alabama	river	reservoirs
Orange-footed pimpleback	<u>Plethobasis cooperianus</u>	Tennessee River in Tennessee and Alabama, Duck River in Tennessee	river	reservoirs
Rough pigtoe pearly mussel	<u>Pleurobema plenum</u>	Tennessee River, Tennessee, Green River, Kentucky; Clinch River, Virginia and Tennessee	river	acid drainage, reservoirs
Cumberland monkey-face pearly mussel	<u>Quadrula intermedia</u>	Powell and Clinch Rivers in Virginia and Tennessee Duck River, Tennessee	river	reservoirs
Appalachian monkeyface pearly mussel	<u>Quadrula sparsa</u>	Powell and Clinch Rivers in Virginia and Tennessee; Duck River, Tennessee	river	reservoirs
Pale lilliput pearly mussel	<u>Toxolasma cylindrella</u>	Duck river, Tennessee; Paint Rock River, Alabama	river	reservoirs
Cumberland bean pearly mussel	<u>Villosa trabilia</u>	Cumberland and Rock-castle Rivers, Kentucky	river	acid drainage, reservoirs
Yellow-blossom pearly mussel	<u>Epioblasma florentina florentina</u>	Duck River, Tennessee	river	acid drainage, reservoirs
Turgid-blossom pearly mussel	<u>Epioblasma turgidula</u>	Duck River, Tennessee	river	acid drainage, reservoirs
<u>Endangered Plants</u>				
Texas Wild Rice	<u>Zizania texana</u>	San Marcos River, Texas	warm spring-fed waters	habitat loss
Rydberg milk-vetch	<u>Astragalus perianus</u>	Utah	grasslands	habitat loss

TABLE D-4
 NUMBER OF SPECIES (BY CATEGORY) CONSIDERED BY STATES AS
 ENDANGERED, THREATENED, OR WORTHY OF SPECIAL CONSIDERATION

STATE	MAMMALS	BIRDS	FISH	AMPHIBIANS/ REPTILES	INVERTEBRATES	PLANTS
Alabama	7	11	17	16	61	-
Arizona	15	30	23	4	-	-
Colorado	6	8	11	-	-	-
Georgia	9	13	9	14	20	94
Illinois	8	40	13	11	-	-
Indiana	14	4	21	21	17	-
Iowa	25	28	35	23	-	100
Kansas	2	6	6	6	6	-
Kentucky	9	5	5	11	-	28
Maryland	7	-	-	14	-	-
Missouri	15	19	32	15	57	360
Montana	2	2	-	-	-	-
Nebraska	2	2	2	-	-	-
New Mexico	13	34	29	27	1	-
North Dakota	7	-	-	-	-	-
Ohio	4	7	40	8	17	-
Oklahoma	3	7	-	1	-	-
Pennsylvania	-	-	4	11	-	-
South Dakota	1	-	-	-	-	-
Tennessee	4	13	19	3	17	-
Texas	14	12	11	9	-	-
Utah	36	*	*	12	1	264
Virginia	7	4	-	9	-	-
West Virginia	2	3	-	-	3	360
Wyoming	5	8	13	5	-	-

* All species protected

TABLE D-5

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
NO NEW FEDERAL LEASING - LOW LEVEL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	263670	1398490	-	92740	2364100	521090	-	325470	-	81660	18460	70000	2640000	920000	660000	530	120400
Central Appalachian	147150	812420	-	74050	593040	273510	-	35720	-	-	10300	40000	1470000	520000	370000	290	67190
Southern Appalachian	111600	594820	-	46470	474760	402300	357	-	-	-	7810	30000	1120000	390000	280000	220	50960
Eastern Interior	260550	604920	-	67370	8983440	2087510	-	619830	-	-	15630	50000	2610000	910000	650000	520	153260
Western Interior	132820	322390	116720	51410	1562900	437900	267	577420	-	-	3980	30000	1330000	460000	330000	270	51080
Texas	171080	587960	338270	45320	-	-	1900	198900	-	-	10260	30000	1710000	600000	600000	340	25920
Powder River	67830	20470	401570	3290	-	-	-	60320	710	3140	2740	2035	610000	70000	170000	140	4380
Green River-Flam Fork	49920	67400	69890	3030	17220	-	-	19920	730	840	1010	8000	2750000	120000	220000	100	5370
Fort Union	35060	10130	129170	5990	-	-	-	194980	-	61180	1490	4910	320000	40000	90000	70	4280
San Juan River	22730	83750	36740	1430	4530	-	8	7890	170	-	40	4550	110000	60000	60000	70	2060
Uinta-Southwestern Utah	25500	59470	28390	1370	8310	-	-	8970	280	-	260	5100	130000	60000	70000	50	3070
Denver-Raton Mesa	21960	37380	94100	4880	61230	-	< 1	57950	1740	-	340	4390	200000	50000	60000	40	1350

TABLE D-6

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
NO NEW FEDERAL LEASING - LOW LEVEL PRODUCTION
1986 - 1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	122240	648355	-	42995	1096020	241585	-	150890	-	37860	8555	30000	1220000	430000	305000	245	55815
Central Appalachian	77555	428185	-	39030	312565	144155	-	18825	-	-	5430	20000	775000	270000	195000	155	35415
Southern Appalachian	53565	285495	-	22305	227870	193090	171	-	-	-	3750	15000	535000	185000	135000	105	24460
Eastern Interior	131265	304765	-	33940	4525855	1051690	-	312270	-	-	7875	25000	1315000	460000	330000	265	77215
Western Interior	66975	162565	58855	25925	788100	220815	135	291165	-	-	2010	15000	670000	235000	165000	135	25760
Texas	107595	369780	212745	28505	-	-	1195	125090	-	-	6455	29000	1075000	375000	375000	215	16300
Powder River	42275	12755	250280	2050	-	-	-	37595	445	1960	1710	1270	380000	40000	105000	85	2725
Green River-Rams Fork	37165	50170	52030	2255	12815	-	-	14830	545	625	755	5950	2045000	95000	165000	75	3995
Fort Union	25575	7390	94225	4370	-	-	-	142230	-	44625	1080	3580	230000	25000	65000	50	3120
San Juan River	17205	63395	27810	1085	3425	-	6	5970	125	-	30	3440	85000	45000	45000	50	1560
Uinta-Southwestern Utah	17060	39785	18995	915	5560	-	-	6000	190	-	175	3410	85000	45000	45000	35	2055
Denver-Raton Mesa	17155	29200	73510	3810	47830	-	< 1	45265	1360	-	270	3430	155000	45000	45000	35	1050

TABLE D-7

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
NO NEW FEDERAL LEASING - MID LEVEL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	258700	1372130	-	90990	2319540	511270	-	319340	-	80140	18110	60000	2590000	910000	650000	520	118130
Central Appalachian	157960	872100	-	79490	636610	293610	-	38340	-	-	11060	40000	1580000	550000	390000	320	72130
Southern Appalachian	153010	815530	-	63710	650920	551570	489	-	-	-	10710	40000	1530000	540000	380000	310	69870
Eastern Interior	262950	610510	-	67990	9066190	2106740	-	625540	-	-	15780	50000	2630000	920000	660000	530	154680
Western Interior	163860	397730	144000	63430	1928150	540240	329	712360	-	-	4920	30000	1640000	570000	410000	330	63020
Texas	327070	814760	468750	63810	-	-	2632	275620	-	-	14270	50000	2370000	830000	830000	470	35920
Powder River	84260	25420	498840	4090	-	-	-	74940	890	3900	3410	2500	760000	80000	21000	170	5440
Green River-Hams Fork	82100	110830	114940	4990	28310	-	-	32760	1210	1380	1650	13100	4520000	210000	370000	160	8830
Fort Union	41900	12110	154370	7160	-	-	-	233020	-	73110	1780	5900	380000	40000	100000	80	5110
San Juan River	31000	114220	50110	1960	6170	-	11	10750	230	-	50	6200	150000	80000	80000	90	2810
Uinta-Southwestern Utah	27930	65130	31100	1500	9100	-	-	9820	310	-	28	5600	140000	70000	70000	60	3370
Denver-Raton Mesa	29210	49720	125170	6490	81440	-	<1	77080	2310	-	460	5800	260000	70000	80000	60	1790

TABLE D-8

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSSES BASED ON
NO NEW FEDERAL LEASING - MID LEVEL PRODUCTION
1986 - 1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	140625	745865	-	49465	1260860	277915	-	173585	-	43555	9845	35000	1405000	490000	350000	280	64210
Central Appalachian	93310	515165	-	46955	376060	173440	-	22650	-	-	6530	25000	935000	325000	235000	185	42605
Southern Appalachian	81555	434680	-	33960	346945	293990	260	-	-	-	5710	20000	815000	285000	205000	165	37240
Eastern Interior	141965	329605	-	36705	4894775	1137415	-	337725	-	-	8520	30000	1420000	495000	355000	285	83510
Western Interior	129380	314040	113695	50080	1522425	426560	260	562460	-	-	3880	25000	1295000	455000	325000	260	49760
Texas	218420	750660	431875	57865	-	-	2425	253935	-	-	13105	45000	2185000	765000	765000	435	33095
Powder River	62675	18910	371050	3045	-	-	-	55740	660	2905	2530	1880	575000	65000	155000	125	4045
Green River-Hams Fork	49110	66295	68755	2980	16935	-	-	19595	725	825	995	7850	2700000	125000	220000	100	5280
Fort Union	42585	12310	156895	7280	-	-	-	236830	-	74305	1805	5960	385000	45000	106000	85	5195
San Juan River	32150	118460	51970	2030	6405	-	12	11155	235	-	50	6400	160000	80000	85000	95	2910
Uinta-Southwestern Utah	17195	40095	19145	920	5605	-	-	6045	190	-	175	3400	85000	45000	45000	35	2070
Denver-Raton Mesa	22615	38495	96910	5025	63050	-	<1	59675	1790	-	360	4520	205000	55000	60000	45	1385

TABLE D-9

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
NO NEW FEDERAL LEASING - HIGH LEVEL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	267110	1416730	-	93950	2394940	527890	-	329720	-	82730	18700	70000	2670000	930000	670000	530	121970
Central Appalachian	147540	814570	-	74250	594620	27240	-	35810	-	-	10330	40000	1480000	520000	370000	300	67370
Southern Appalachian	159700	851190	-	66500	679380	575690	510	-	-	-	11180	40000	160000	560000	400000	320	72920
Eastern Interior	258350	599830	-	66800	8907590	2069890	-	614600	-	-	15550	50000	2580000	900000	650000	520	151970
Western Interior	168160	408170	147780	65090	1978750	554420	338	731050	-	-	5040	30000	1680000	590000	420000	340	64680
Texas	226490	778390	447830	60000	-	-	2515	263320	-	-	13590	50000	2260000	790000	790000	450	34320
Powder River	109470	33030	648090	5310	-	-	-	97360	1150	5070	4420	3290	990000	110000	270000	220	7060
Green River-Hams Fork	101060	136430	141480	6140	34850	-	-	40330	1490	1700	2050	16200	5560000	250000	450000	200	10870
Fort Union	74900	21640	275960	12800	-	-	-	416540	-	130690	3170	10500	670000	70000	190000	150	9130
San Juan River	48840	179950	78950	3080	9730	-	18	16940	360	-	80	9770	240000	120000	130000	150	4420
Uinta-Southwestern Utah	32480	75740	36160	1740	10590	-	-	11420	360	-	320	6500	160000	80000	80000	60	3910
Denver-Raton Mesa	35770	60890	153280	7950	99730	-	< 1	94390	2830	-	560	7150	320000	90000	90000	70	2190

TABLE D-10
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
 TO WILDLIFE DUE TO HABITAT LOSS BASED ON
 NO NEW FEDERAL LEASING - HIGH LEVEL PRODUCTION
 1986 - 1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	204000	1082000	-	71755	1829090	403165	-	251815	-	63185	14280	50000	2040000	715000	510000	410	93150
Central Appalachian	105740	583790	-	53210	426155	196545	-	25670	-	-	7400	25000	1055000	370000	265000	210	48285
Southern Appalachian	104560	557300	-	43540	444810	376920	334	-	-	-	7320	25000	1045000	365000	260000	210	47745
Eastern Interior	157770	366300	-	40795	5439710	1264045	-	375325	-	-	9465	30000	1580000	550000	395000	315	92805
Western Interior	154430	374840	135710	59775	1817190	509150	310	671365	-	-	4635	30000	1545000	540000	385000	310	59395
Texas	243380	836440	481230	64480	-	-	2703	282950	-	-	14605	50000	2435000	850000	850000	485	36875
Powder River	66106	19965	391685	3210	-	-	-	58840	695	3065	2675	2000	595000	65000	165000	130	4270
Green River-Hams Fork	55985	75580	78380	3400	19310	-	-	22340	825	940	1130	9000	3080000	140000	250000	110	6020
Fort Union	56435	16310	207925	9645	-	-	-	313850	-	98470	2390	7900	510000	55000	140000	115	6880
San Juan River	47460	174865	76720	2995	9455	-	18	16465	350	-	75	9500	235000	120000	125000	140	4300
Uinta-Southwestern Utah	22435	52320	24980	1205	7310	-	-	7890	245	-	225	4500	110000	55000	60000	45	2705
Denver-Raton Mesa	26075	44385	111735	5790	72700	-	<1	68805	2065	-	410	5220	235000	65000	70000	50	1600

TABLE D-11

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE
DUE TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
LOW-LEVEL COAL PRODUCTION
1976-1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	263720	1398750	-	92760	2364550	521190	-	325530	-	81680	18460	70000	2640000	920000	660000	530	120420
Central Appalschian	147150	812420	-	74050	593040	273510	-	35720	-	-	10300	40000	1470000	520000	370000	290	67190
Southern Appalachian	111600	594820	-	46470	474760	402300	356	-	-	-	7810	30000	1120000	390000	280000	220	50960
Eastern Interior	260550	594820	-	67370	8983440	2087510	-	619830	-	-	15630	50000	2610000	910000	650000	520	153260
Western Interior	132750	322220	116660	51380	156080	437670	267	577110	-	-	3980	30000	1330000	460000	330000	270	51060
Texas	171290	588680	338690	45380	-	-	1902	199140	-	-	10280	30000	1710000	600000	600000	340	25950
Powder River	67830	20470	401570	3290	-	-	-	60320	710	3140	2740	2000	610000	70000	170000	140	4380
Green River-Hams Fork	49920	67400	69890	3030	17220	-	-	19920	730	840	1010	8000	2750000	120000	220000	100	5370
Fort Union	38050	10990	140190	6500	-	-	-	211610	-	66390	1610	5300	340000	40000	100000	80	4640
San Juan River	22730	83750	36740	14301	4530	-	8	7890	170	-	40	4550	110000	60000	60000	70	2060
Uinta-Southwestern Utah	25500	59470	28390	1370	8310	-	-	9970	280	-	300	5100	130000	60000	70000	50	3070
Denver-Raton Mesa	21960	37380	94100	4880	61230	-	1	57950	1740	-	340	4400	200000	50000	60000	40	1350

TABLE D-12
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE
 TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
 LOW LEVEL PRODUCTION
 1986 - 1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	124025	657820	-	43625	1112025	245110	-	153095	-	38415	8680	30000	1240000	435000	310000	250	56630
Central Appalachian	77535	428070	-	39020	312480	144115	-	18820	-	-	5425	20000	775000	270000	195000	155	35405
Southern Appalachian	53565	285495	-	22305	227870	193090	171	-	-	-	3750	15000	535000	185000	135000	105	24460
Eastern Interior	131270	304775	-	33940	4526025	1051730	-	312280	-	-	7875	25000	1315000	460000	330000	265	77220
Western Interior	66950	162505	58835	25915	787805	220730	135	291055	-	-	2010	15000	670000	235000	165000	135	25750
Texas	107000	367735	211570	28345	-	-	1188	124395	-	-	6420	20000	1070000	375000	375000	215	16210
Powder River	42360	12780	250780	2055	-	-	-	37670	445	1945	1710	1270	380000	40000	105000	85	2735
Green River-Hams Fork	38490	51965	53885	2335	13275	-	-	15360	565	645	780	6160	2115000	95000	175000	75	4140
Fort Union	25575	7390	94225	4370	-	-	-	142230	-	44625	1080	3580	230000	25000	65000	50	3120
San Juan River	17400	64110	28125	1100	3465	-	6	6035	130	-	30	3500	75000	45000	45000	100	1575
Uinta-Southwestern Utah	17540	40900	19530	940	5715	-	-	6165	195	-	175	3510	90000	45000	45000	70	2115
Denver-Raton Mesa	17210	29295	73745	3825	47985	-	1	45410	1360	-	270	3440	155000	45000	45000	35	1055

TABLE D-13

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE
TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
MID-LEVEL PRODUCTION
1976-1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	258650	1371860	--	90980	2319090	511170	--	319270	--	80110	18110	60000	2590000	910000	650000	520	118100
Central Appalachian	156890	866200	--	78950	632300	291620	--	38080	--	--	10980	40000	1570000	550000	390000	310	71640
Southern Appalachian	149900	798960	--	62420	637690	540360	479	--	--	--	10490	40000	1500000	520000	370000	300	68450
Eastern Interior	264300	613630	--	68340	9112740	2117560	--	628750	--	--	15860	50000	2640000	930000	660000	530	155470
Western Interior	157150	381450	138100	60830	1849200	518120	315	683190	--	--	4710	30000	1570000	550000	390000	310	60440
Texas	239670	823690	473890	63500	--	--	2661	278640	--	--	14380	50000	2400000	840000	840000	480	36310
Tender River	84460	25480	500020	4100	--	--	--	75110	890	3910	3410	2530	760000	80000	210000	170	5450
Green River-Hams Fork	85710	115710	119990	5200	29560	--	--	34200	1260	1440	1730	13710	4710000	210000	190000	170	9220
Fort Union	45050	13020	165980	7700	--	--	--	250540	--	78610	1900	6310	410000	50000	110000	90	5490
San Juan River	31090	114550	50260	1960	6190	--	12	10790	230	--	50	6220	160000	80000	80000	90	2820
Flinta-Southwestern Utah	28690	66910	31940	1540	9350	--	--	10090	320	--	290	5740	140000	70000	70000	60	3460
Denver-Raton Mesa	30480	51880	130610	6770	84980	--	<1	80430	2410	--	480	6100	270000	80000	80000	60	1870

TABLE D-14

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE
TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
MID-LEVEL PRODUCTION
1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/Reptiles	Predators	Animal Units
Northern Appalachian	140810	746845	- -	49530	1262520	278285	- -	173815	- -	43610	9855	35000	1410000	495000	350000	280	64295
Central Appalachian	92370	509975	- -	46485	372270	171690	- -	22420	- -	- -	6465	25000	925000	325000	230000	185	42180
Southern Appalachian	81315	433405	- -	33860	345920	293125	260	- -	- -	- -	5690	20000	815000	285000	205000	165	37130
Eastern Interior	140195	325500	- -	36250	4833750	1123235	- -	333515	- -	- -	8410	30000	1400000	490000	350000	280	82470
Western Interior	126075	306020	110795	48800	1483535	415665	253	548095	- -	- -	3780	25000	1260000	440000	315000	250	48490
Texas	205215	705275	405765	54365	- -	- -	2279	238580	- -	- -	12315	40000	2050000	720000	720000	410	31095
Powder River	77165	23280	456835	3745	- -	- -	- -	68625	810	3575	3120	2315	695000	75000	195000	155	4980
Green River-Hams Fork	57330	77395	80260	3480	19770	- -	- -	22875	845	965	1160	9170	3155000	145000	260000	115	6165
Fort Union	40105	11590	147760	6855	- -	- -	- -	223035	- -	69980	1700	5615	360000	40000	100000	80	4890
San Juan River	28535	105140	46125	1800	5685	- -	11	9900	210	- -	45	5710	145000	70000	75000	85	2585
Uinta-Southwestern Utah	16945	39515	18865	910	5525	- -	- -	5960	185	- -	170	3400	85000	40000	45000	35	2040
Denver-Raton Mesa	22655	38560	97080	5030	63165	- -	<1	59780	1795	- -	360	4530	205000	55000	60000	45	1390

TABLE D-15

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE
TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
HIGH-LEVEL COAL PRODUCTION
1976-1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	266480	141339	- -	93730	2389290	526640	- -	328940	- -	82530	18650	70000	2660000	930000	670000	530	121680
Central Appalachian	145150	801370	- -	73040	584980	269800	- -	35230	- -	- -	10160	40000	1450000	510000	360000	290	66280
Southern Appalachian	159150	848260	- -	66270	677040	573710	508	- -	- -	- -	11140	40000	1590000	560000	400000	320	72670
Eastern Interior	255850	594020	- -	66150	8821390	2049860	- -	608650	- -	- -	15350	50000	2560000	900000	640000	510	150500
Western Interior	179240	435060	157510	69380	2109130	590950	360	779220	- -	- -	5380	40000	1790000	630000	450000	360	68940
Texas	207980	714780	411230	55100	- -	- -	2309	241800	- -	- -	1248	40000	2080000	730000	730000	420	31510
Powder River	117600	35480	696220	5710	- -	- -	- -	104590	1240	5450	4760	3530	1060000	120000	290000	240	7590
Green River-Hams Fork	125390	169270	175550	7610	43240	- -	- -	50040	1850	2110	2540	20000	6900000	310000	560000	250	13480
Fort Union	75430	21800	277910	12890	- -	- -	- -	419490	- -	131620	3190	10560	680000	80000	190000	150	9200
San Juan River	49010	180580	79220	3090	9760	- -	18	17000	360	- -	80	9800	250000	120000	130000	150	4440
Uinta-Southwestern Utah	33090	77160	36840	1770	10780	- -	- -	11630	360	- -	330	6620	170000	80000	90000	70	3990
Denver-Raton Mesa	36410	61970	156020	8090	101510	- -	<1	96080	2880	- -	580	7280	330000	90000	90000	70	2230

TABLE D-16

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE
TO HABITAT LOSS BASED ON THE PREFERRED PROGRAM ALTERNATIVE
HIGH-LEVEL COAL PRODUCTION
1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	206905	1097410	-	72775	1855135	408905	-	255400	-	64080	14485	50000	2070000	725000	515000	415	94475
Central Appalachian	104920	579265	-	52800	422850	195020	-	25470	-	-	7345	25000	1050000	365000	260000	210	47910
Southern Appalachian	110695	545470	-	46095	470925	399035	354	-	-	-	7750	30000	1105000	385000	275000	220	50545
Eastern Interior	157795	313710	-	40800	5440575	1264245	-	375385	-	-	9470	30000	1580000	550000	395000	315	92820
Western Interior	142830	346690	125515	55285	1680690	470905	287	620935	-	-	4285	30000	1430000	500000	355000	285	54935
Texas	223415	767825	441750	59190	-	-	2481	259740	-	-	13405	45000	2235000	780000	780000	445	33850
Powder River	108835	32835	644330	5285	-	-	-	96790	1145	5045	4400	8270	980000	110000	270000	220	7020
Green River-Hams Fork	79655	107535	111515	4835	27470	-	-	31785	1175	1340	1615	12740	4380000	200000	360000	160	8565
Fort Union	53020	15325	195340	9065	-	-	-	294860	-	92515	2240	7420	475000	550000	135000	105	6465
San Juan River	46685	172015	75465	2945	9300	-	17	16195	345	-	75	9340	235000	115000	120000	140	4230
Uinta-Southwestern Utah	23240	54195	25875	1245	7575	-	-	8170	255	-	235	4650	115000	60000	60000	45	2800
Denver-Raton Mesa	28550	48595	122340	6340	79600	-	< 1	73535	2260	-	450	5710	255000	70000	75000	55	1750

TABLE D-17

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE DUE TO
HABITAT LOSS BASED ON PREFERENCE RIGHT LEASING APPLICATIONS ONLY LEASING
MID-LEVEL COAL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/Reptiles	Predators	Animal Units
Northern Appalachian	251510	1333990	-	88470	2255070	497060	-	310460	-	77900	17610	60000	2520000	880000	630000	500	114840
Central Appalachian	157560	870110	-	79310	635160	292940	-	38260	-	-	11030	40000	1580000	550000	390000	320	71960
Southern Appalachian	150640	802910	-	62730	640840	543030	481	-	-	-	10540	40000	1510000	530000	380000	300	68790
Eastern Interior	262430	609290	-	67860	9048060	2102580	-	624300	-	-	15750	50000	2620000	920000	660000	520	154370
Western Interior	155220	376760	136410	60080	1826480	511750	312	674800	-	-	4660	30000	1550000	540000	390000	310	59700
Texas	235320	808740	465290	62340	-	-	2613	273580	-	-	14120	50000	2350000	820000	820000	470	35650
Poudre River	84310	25430	499140	4090	-	-	-	74980	890	3910	3410	2530	760000	80000	210000	170	5440
Green River-Hams Fork	83160	112270	116420	5050	28680	-	-	33180	1220	1400	1690	13310	4570000	210000	370000	170	8940
Fort Union	45060	13020	166020	7700	-	-	-	250590	-	78620	1900	6310	410000	50000	110000	90	5500
San Juan River	30930	113960	50000	1950	6160	-	11	10730	230	-	50	6190	150000	80000	80000	90	2800
Uinta-Southwestern Utah	28130	65600	31320	1510	9170	-	-	9890	310	-	290	5630	140000	70000	70000	60	3390
Denver-Raton Mesa	30420	51780	130350	6760	84810	-	< 1	80270	2410	-	480	6080	270000	80000	80000	60	1870

TABLE D-18

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION
AND TO WILDLIFE DUE TO HABITAT LOSS BASED ON
PREFERENCE RIGHT LEASING APPLICATIONS ONLY LEASING,
MID-LEVEL COAL PRODUCTION 1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	140590	745675	-	49450	1260545	277850	-	17350	-	43545	9840	35000	1405000	490000	350000	280	64195
Central Appalachian	94260	520410	-	47435	379885	175205	-	22880	-	-	6600	25000	945000	330000	235000	190	43040
Southern Appalachian	82280	405450	-	34260	350030	296605	263	-	-	-	5760	20000	825000	290000	205000	165	37570
Eastern Interior	140515	326240	-	36330	4844785	1125800	-	334275	-	-	8430	30000	1405000	490000	350000	280	82655
Western Interior	124420	302000	109340	48160	1464060	410210	250	540900	-	-	3735	25000	1245000	435000	310000	250	47855
Texas	214455	737035	424035	56815	-	-	2381	249325	-	-	12865	45000	2145000	750000	750000	430	32495
Powder River	69950	21105	414120	3395	-	-	-	62210	735	3240	2830	2100	630000	70000	175000	140	4515
Green River-Hams Fork	48735	65790	68230	2960	16810	-	-	19445	715	820	985	7800	2680000	120000	220000	95	5240
Fort Union	42035	12145	154870	7185	-	-	-	233770	-	73345	1780	5880	380000	40000	105000	85	5125
San Juan River	30485	112320	49280	1925	6070	-	11	10575	225	-	50	6100	150000	75000	80000	90	2760
Uinta-Southwestern Utah	16280	37965	18125	875	5305	-	-	5725	180	-	55	3250	800000	40000	40000	35	1960
Denver-Raton Mesa	22200	37785	95130	4930	61895	-	< 1	58580	1755	-	350	4440	200000	55000	60000	45	1360

TABLE D-19

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
SHORT TERM LEASING, MID LEVEL COAL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	251460	1333730	-	88450	2254620	496960	-	310400	-	77880	17600	60000	2510000	880000	630000	500	11482
Central Appalachian	157220	868010	-	79120	633630	292230	-	38160	-	-	11010	40000	1570000	550000	390000	310	71790
Southern Appalachian	150880	804180	-	62830	641860	543900	482	-	-	-	10560	40000	1510000	530000	380000	300	68890
Eastern Interior	262960	610530	-	67990	9066540	2106820	-	625560	-	-	15780	50000	2630000	920000	660000	530	154680
Western Interior	156370	379550	137420	60530	1840020	515550	314	679800	-	-	4690	30000	1560000	550000	390000	310	60140
Texas	236710	813520	468040	62710	-	-	2620	275200	-	-	14200	50000	2370000	830000	830000	470	35870
Powder River	84370	25460	499490	4100	-	-	-	75030	890	3910	3410	2530	760000	800000	210000	170	5440
Green River-Hams Fork	82880	111890	116030	5030	28580	-	-	33070	1220	1390	1680	13260	4560000	210000	370000	170	8910
Fort Union	45060	13020	166020	7700	-	-	-	250590	-	78620	1900	6300	410000	50000	110000	90	5500
San Juan River	30930	113960	50000	1950	6160	-	11	10730	230	-	50	6190	150000	80000	80000	90	2800
Uinta-Southwestern Utah	28220	65810	31420	1510	9200	-	-	9920	310	-	290	5650	140000	70000	70000	60	3400
Denver-Raton Mesa	30420	51780	130350	6760	84810	-	< 1	80270	2410	-	480	6080	270000	80000	80000	60	1870

TABLE D-20

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
SHORT TERM LEASING, MID LEVEL COAL PRODUCTION
1986 - 1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	140625	745865	-	49465	1260860	277915	-	173585	-	43555	9845	35000	1405000	490000	350000	280	64210
Central Appalachian	93125	514145	-	46865	375315	173095	-	22605	-	-	6520	25000	930000	325000	235000	185	42525
Southern Appalachian	81610	434980	-	33985	347175	294190	261	-	-	-	5715	20000	815000	285000	205000	165	37265
Eastern Interior	140895	327120	-	36430	4857885	1128845	-	335180	-	-	8455	30000	1410000	495000	350000	280	82880
Western Interior	126215	306355	110910	48855	1485180	416125	254	548700	-	-	3785	25000	1260000	440000	315000	250	48545
Texas	214660	737735	424440	56870	-	-	32384	249560	-	-	12880	45000	2145000	750000	750000	430	32525
Foudre River	63970	19300	378720	3105	-	-	-	56890	670	2965	2590	1920	575000	65000	160000	130	4125
Green River-Hams Fork	50065	67590	70090	3040	17265	-	-	19980	735	840	1015	7010	2755000	125000	225000	100	5385
Fort Union	43130	12465	158905	7370	-	-	-	239860	-	75255	1825	6040	390000	45000	110000	85	5260
San Juan River	31705	116820	51250	2000	6305	-	12	11000	235	-	50	6340	160000	80000	80000	95	2870
Uinta-Southwestern Utah	16555	38605	18430	885	5395	-	-	5820	180	-	165	3310	85000	40000	45000	35	1995
Denver-Raton Mesa	22270	37905	95430	4945	62090	-	< 1	58765	1765	-	350	4450	200000	55000	60000	45	1365

TABLE D-21

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE
DUE TO HABITAT LOSS BASED ON LEASING TO MEET INDUSTRY NEEDS,
MID-LEVEL PRODUCTION
1976 - 1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	251010	1331330	-	88290	2250590	496070	-	309840	-	77740	17570	60000	2510000	880000	630000	500	114620
Central Appalachian	151730	837710	-	76360	611500	282030	-	36830	-	-	10620	40000	1520000	530000	380000	300	69280
Southern Appalachian	152960	815270	-	63690	650710	551390	489	-	-	-	10710	40000	1530000	540000	380000	310	69840
Eastern Interior	260930	605810	-	67470	8996540	2090560	-	620730	-	-	15660	50000	2610000	910000	650000	520	153490
Western Interior	154050	373920	135380	59630	1812720	507900	310	669710	-	-	4620	30000	1540000	540000	390000	310	59250
Texas	223630	768570	442180	59250	-	-	2483	259990	-	-	13420	40000	2240000	780000	780000	450	33880
Powder River	91110	27490	539390	4420	-	-	-	81030	9600	4220	3680	2730	820000	90000	230000	180	5880
Green River-Hams Fork	111740	150840	156440	6780	38540	-	-	44590	1640	1880	2260	17880	6150000	280000	500000	220	12020
Fort Union	49410	14280	182040	8450	-	-	-	274780	-	86210	2080	6920	440000	50000	120000	100	6030
San Juan River	35080	129250	56710	2210	6990	-	13	12170	260	-	60	7000	180000	90000	90000	110	3180
Uinta-Southwestern Utah	29780	69450	33160	1600	9710	-	-	10470	330	-	300	6000	150000	70000	80000	60	3590
Denver-Haton Mesa	33670	57310	144280	7480	93870	-	<1	88850	2660	-	540	6730	300000	80000	90000	70	2070

TABLE D-22
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE
 DUE TO HABITAT LOSS BASED ON LEASING TO MEET INDUSTRY NEEDS,
 MID-LEVEL PRODUCTION
 1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	140350	744405	-	49365	1258395	277275	-	173245	-	43470	9825	35000	1405000	490000	350000	280	64085
Central Appalachian	92935	513095	-	46770	374545	172740	-	22560	-	-	6505	25000	930000	325000	230000	185	42435
Southern Appalachian	82860	441635	-	34505	325495	298695	265	-	-	-	5800	20000	830000	290000	205000	165	37835
Eastern Interior	135675	315000	-	35080	4677905	1087020	-	322760	-	-	8140	25000	1355000	475000	340000	270	79810
Western Interior	127215	308785	111795	49240	1496945	419425	256	553050	-	-	3815	25000	1270000	445000	320000	255	48930
Texas	192010	659895	379655	50870	-	-	2132	223230	-	-	11520	40000	1920000	670000	670000	385	29090
Powder River	84970	25635	503045	4125	-	-	-	75565	895	3935	3440	2550	765000	85000	210000	170	5480
Green River-Hams Fork	69550	93890	97370	4225	23985	-	-	27755	1025	1170	1405	11130	3825000	175000	315000	140	7480
Fort Union	44750	12935	164875	7650	-	-	-	248870	-	78085	1890	6270	405000	45000	110000	90	5455
San Juan River	32505	119765	52545	2050	6475	-	12	11275	240	-	50	6500	165000	80000	85000	100	2945
Uinta-Southwestern Utah	17745	41385	19755	950	5785	-	-	6240	195	-	175	3550	90000	45000	45000	70	2140
Denver-Raton Mesa	24015	40875	102905	5335	66955	-	<1	63370	1900	-	380	4800	215000	60000	60000	50	1475

TABLE D-23
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
 TO WILDLIFE DUE TO HABITAT LOSS BASED ON
 DEPARTMENT OF ENERGY GOALS
 MID-LEVEL COAL PRODUCTION
 1976-1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	258620	1371700	-	90970	2318820	511110	-	319240	-	80100	18100	60000	2590000	910000	650000	520	118090
Central Appalachian	156670	864980	-	78840	631410	291210	-	38030	-	-	10970	40000	1570000	550000	390000	310	71540
Southern Appalachian	145000	772840	-	60380	616850	522700	463	-	-	-	10150	40000	1450000	510000	360000	290	66210
Eastern Interior	256550	595640	-	66330	8845520	2055470	-	610310	-	-	15390	50000	2570000	900000	640000	510	150910
Western Interior	163920	397880	144050	63450	1928860	540440	329	712620	-	-	4920	30000	1640000	570000	410000	330	63050
Texas	231370	795160	61300	-	-	2569	2569	268990	-	-	13880	50000	2310000	810000	810000	460	35060
Poudre River	83930	25330	496890	4070	-	-	-	74640	880	3890	3400	2500	760000	800000	210000	170	5410
Green River-Hams Fork	111360	150330	155900	6760	38410	-	-	44440	1640	1870	2250	18000	6120000	280000	50000	220	11970
Fort Union	37140	10730	136840	6350	-	-	-	206550	-	64800	1570	5200	330000	40000	90000	70	4530
San Juan River	27470	101210	44410	1730	5470	-	10	9530	200	-	40	5500	140000	70000	70000	80	2490
Uinta-Southwestern Utah	28080	65480	31260	1510	9150	-	-	9870	310	-	290	5600	140000	70000	70000	60	3380
Denver-Raton Mesa	36260	61720	155380	8050	101100	-	1	95680	2870	-	580	7200	330000	90000	90000	70	2220

TABLE D-24

POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND
TO WILDLIFE DUE TO HABITAT LOSS BASED ON
DEPARTMENT OF ENERGY GOALS
MID-LEVEL COAL PRODUCTION
1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	141190	748860	-	49660	1265925	279035	-	174285	-	43730	9885	35000	1410000	495000	355000	280	64470
Central Appalachian	92160	508815	-	46380	371425	171300	-	22370	-	-	6450	25000	920000	325000	230000	185	42080
Southern Appalachian	78755	419760	-	32795	335030	283900	252	-	-	-	5515	20000	790000	275000	195000	160	35960
Eastern Interior	137660	319610	-	35595	4746350	1102905	-	327485	-	-	8260	30000	1375000	480000	345000	275	80975
Western Interior	125815	305385	110565	48700	1480475	414810	253	546965	-	-	3775	25000	1260000	440000	315000	250	48390
Texas	201755	693385	398925	53450	-	-	2240	234560	-	-	12105	40000	2020000	705000	705000	405	30570
Powder River	76580	23105	453375	3720	-	-	-	68105	805	3550	3100	2300	690000	75000	190000	155	4940
Green River-Hams Fork	68960	93095	96545	4185	237850	-	-	27520	1015	1160	1400	11000	3795000	170000	310000	140	7415
Fort Union	31680	9155	116720	5415	-	-	-	176180	-	55280	1340	4400	285000	30000	80000	65	3865
San Juan River	30900	113850	49950	1950	6155	-	12	10720	225	-	50	6180	155000	75000	80000	95	2800
Uinta-Southwestern Utah	15640	36470	17415	840	5095	-	-	5500	170	-	160	3100	80000	40000	40000	30	1885
Denver-Raton Mesa	22715	38665	97335	5045	63330	-	1	59940	1800	-	360	4500	205000	55000	60000	45	1395

TABLE D-25
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE
 DUE TO HABITAT LOSS BASED ON STATE DETERMINATION,
 MID-LEVEL COAL PRODUCTION
 1976-1985

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	251240	1332560	--	88370	2252650	496530	--	310130	--	77810	17590	60000	2510000	880000	630000	500	114720
Central Appalachian	159840	882480	--	80440	644190	297100	--	38800	--	--	11190	40000	1600000	560000	400000	320	72990
Southern Appalachian	148140	789580	--	61690	630200	534020	473	--	--	--	10370	40000	1480000	520000	370000	300	67640
Eastern Interior	264040	613030	--	68270	9103770	2115470	--	628130	--	--	15840	50000	2640000	920000	660000	530	155320
Western Interior	187960	456230	165180	72750	2211740	619700	378	817130	--	--	5640	40000	1880000	660000	470000	380	72290
Texas	252570	868030	499400	66910	--	--	2800	293640	--	--	15150	50000	2530000	880000	880000	510	38270
Powder River	77690	23440	459940	3770	--	--	--	69090	820	3600	3140	2330	700000	80000	190000	160	5010
Green River-Hams Fork	67540	91180	94560	4100	23290	--	--	26950	990	1130	1380	10800	3710000	170000	300000	140	7260
Fort Union	49770	14380	183370	8510	--	--	--	276790	--	86840	2110	7000	450000	50000	120000	100	6070
San Juan River	36770	135480	59440	2320	7320	--	14	12760	270	--	60	7350	180000	90000	100000	110	3330
Uinta-Southwestern Utah	28500	66460	31730	1530	9290	--	--	10020	310	--	290	5700	140000	70000	70000	60	3430
Denver-Raton Mesa	31040	52830	133010	6890	86540	--	<1	81910	2460	--	480	6200	280000	80000	80000	60	1900

TABLE D-26
 POTENTIAL LOSSES TO NATURAL AND AGRICULTURAL PRODUCTION AND TO WILDLIFE
 DUE TO HABITAT LOSS BASED ON STATE DETERMINATION,
 MID-LEVEL COAL PRODUCTION
 1986-1990

Coal Region	Total Land Committed (acres)	POTENTIAL PRODUCTIVITY LOSS									POTENTIAL WILDLIFE LOSS						
		Forest (tons)	Range (tons)	Pasture (tons)	Corn (bu)	Soybeans (bu)	Cotton (tons)	Wheat (bu)	Sugarbeets (tons)	Oats (bu)	Game Mammals	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Predators	Animal Units
Northern Appalachian	141480	750400	--	49765	1268525	279605	--	174640	--	43820	9905	35000	1415000	495000	355000	285	64605
Central Appalachian	94385	521100	--	47495	380390	175435	--	22910	--	--	6605	25000	945000	330000	235000	190	43100
Southern Appalachian	77710	414190	--	32360	330585	280130	248	--	--	--	5440	20000	775000	270000	195000	155	35485
Eastern Interior	147465	342375	--	38130	5084410	1181480	--	350810	--	--	8850	30000	1475000	515000	370000	295	86745
Western Interior	125395	304370	110195	48535	1475535	413425	252	545135	--	--	3760	25000	1255000	440000	315000	250	48230
Texas	212800	731345	420765	56375	--	--	2363	247400	--	--	12770	45000	2130000	745000	745000	425	32240
Poudre River	56830	17150	336450	2760	--	--	--	50540	595	2635	2300	1700	510000	55000	140000	115	3665
Green River-Hams Fork	33600	45360	47040	2040	11590	--	--	13410	495	565	680	5400	1850000	85000	150000	65	3615
Fort Union	44390	12830	163545	7580	--	--	--	246865	--	77455	1875	6200	400000	45000	110000	90	5415
San Juan River	33500	123430	54155	2115	6670	--	12	11620	245	--	55	6700	165000	85000	85000	100	3035
Uinta-Southwestern Utah	16215	37815	18055	870	5285	--	--	5700	180	--	165	3240	80000	40000	40000	60	1955
Denver-Raton Mesa	21360	36355	91530	4745	59555	--	<1	56365	1690	--	340	4300	190000	55000	55000	45	1310

APPENDIX D REFERENCES

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APPENDIX E

WATER RESOURCES DATA

TABLE E-1

WATER RESOURCES COUNCIL AGGREGATED SUBREGIONS

Region	Aggregated Subregion (ASR)	Basin	Discharge Point(s)
Ohio	501	Allegheny-Monongahela	Allegheny River at Natrona, Pa., above Pittsburgh; and Monongahela River at Braddock, Pa.
	502	Pittsburgh-Cincinnati Little Miami	Ohio River immediately above Kentucky River Junction
	503	Muskigum-Scioto-Great Miami	The junction of each river with the Ohio River Junction.
	504	Kanawha	Kanawha River at Ohio River junction.
	505	Licking and Kentucky, Louisville-Sale, Evansville-Green	Ohio River at Mississippi River junction.
	506	Wabash	Wabash River at Ohio River junction.
	507	Cumberland	Cumberland River at Ohio River junction.
Tennessee	601	Upper Tennessee	Tennessee River at South Pittsburg, TN
	602	Lower Tennessee	Tennessee River at Ohio River junction.
Mississippi	701	Minnesota-Mississippi-St. Croix	Mississippi River at Prescott, WI
	702	Chippewa-Mississippi-Wisconsin	Mississippi River at Wisconsin river junction.
	703	Mississippi to Quad Cities	Mississippi River at Keokuk, IA, and Des Moines River at Keosauqua, IA
	704	Mississippi-Illinois	Mississippi River immediately above Missouri River (Alton, ID)
	705	Mississippi-Kaskaskia-St. Louis	Mississippi River immediately above Ohio River (Thebes, ID)
Souris-Red-Rainy	901	Souris-Red-Rainy	U.S.-Canadian Border (all discharge points).
Missouri	1001	Missouri-Poplar-Milk	Missouri River near Culbertson, MT
	1002	Missouri headwaters to Marias	Missouri River at Virgelle, MT
	1003	Missouri-Musselshell	Missouri River below Fort Peck Dam, MT
	1004	Yellowstone-Bighorn-Powder	Yellowstone River at Missouri River junction (Sidney, MT)
	1005	Little Missouri-Cheyenne-White to Oahe	Missouri River below Ft. Randall, SD

TABLE E-1
WATER RESOURCES COUNCIL AGGREGATED SUBREGIONS (CONCLUDED)

Region	Aggregated Subregion (ASR)	Basin	Discharge Point(s)
Missouri (concluded)	1006	James-Missouri-Big Sioux	Missouri River at Sioux City, IA
	1007	Upper Platte Basins	North Platte River at Lewellan, NE and South Platte River at Julesburg, CO
	1008	Niobrara-Loup-Platte-Elkhorn	Platte River at Louisville, NE, Niobra River, Verdel, NE
	1009	Missouri-Sioux City to Kansas City	Missouri River at Kansas City, MO minus Kansas River at Bonner Springs, KS
	1010	Republican-Smokey Hill-Blue-Kansas	Kansas River immediately above Missouri River (Bonner Springs, KS)
	1011	Grand-Charitan-Osage-Gasconde-Missouri	Missouri River above Mississippi River Junction (Herman, MO)
Arkansas-White-Red	1101	White	White River at Black River junction (Newport, AR)
	1102	Upper Arkansas	Arkansas River near Coolidge, KS
	1103	Cimarron-Arkansas to Keystone	Arkansas River at Cimarron River junction (Tulsa, OK)
	1104	Verdigris-Neosho-Lower Arkansas	Arkansas River at Little Rock, AR
	1105	Canadian	Canadian River near Whitefield, OK
	1106	Red-Washita	Red River at Dennison Dam, TX
Texas-Gulf	1107	Lower Red	Red River at Alexandria, LA
	1201	Sabine-Neches	Gulf of Mexico
	1202	Trinity-San Jacinto	Gulf of Mexico
	1203	Brazos	Brazos River near Juliff, TX
	1204	Colorado	Gulf of Mexico
	1205	Navidad-Lavaca-Guadalupe-Mission-Nueces	Gulf of Mexico
Upper Colorado	1401	Green-Yampa-White	Green River immediately above Colorado River junction (Green River, UT)
	1402	Gunnison-Colorado-Dolores	Colorado River immediately above Green River junction (near Cisco, UT)
	1403	San Juan-Colorado	Colorado River at Lee's Ferry, AZ

TABLE E-2

CALCULATED PRESENT AND FUTURE FLOW IN THE UPPER OHIO AND UPPER
TENNESSEE RIVER BASINS, CONTAINING THE NORTHERN, CENTRAL, AND
SOUTHERN APPALACHIAN COAL REGIONS

PERIOD	TOTAL STREAM FLOW (b)		1975		1985		2000	
			CONSUMP- TIVE REQUIRE- MENTS (c)	CALCU- LATED FLOW (d)	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW (d)	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW (d)
	MEAN	95%		MEAN		MEAN 95%		MEAN 95%
January	11,700	3,530	128	11,600	186	11,500 3,340	307	11,400 3,200
February	13,900	5,850	127	13,800	186	13,700 5,660	305	13,600 3,540
March	16,000	7,450	130	15,800	189	15,800 7,260	309	15,700 7,140
April	13,000	6,690	131	12,900	188	12,800 6,500	307	12,700 6,380
May	9,090	4,200	135	8,960	194	8,900 4,010	319	8,780 3,880
June	6,550	3,090	140	6,410	199	6,350 2,890	320	6,230 2,770
July	4,740	2,430	143	4,600	206	4,540 2,220	331	4,410 2,100
August	4,160	2,050	143	4,020	205	3,960 1,840	332	3,830 1,720
September	3,350	1,720	135	3,220	195	3,160 1,520	317	3,040 1,400
October	3,390	1,610	133	3,260	190	3,200 1,420	313	3,080 1,300
November	4,830	1,970	130	4,700	190	4,640 1,780	312	4,520 1,660
December	8,210	2,380	131	8,080	193	8,020 2,190	319	7,890 2,060
Annual(e)	98,800	65,100	1,610	97,200	2,320	96,500 62,800	3,790	95,000 61,300

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 502 and 601.

TABLE E-3

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE UPPER MISSISSIPPI AND
OHIO RIVER BASINS, CONTAINING THE EASTERN INTERIOR AND APPALACHIAN COAL
REGIONS

PERIOD	TOTAL STREAM FLOW (b)		1975		1985			2000		
			CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW (d)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW (d)	
	MEAN	95%				MEAN	95%		MEAN	95%
January	21,900	5,800	200	21,700	250	21,700	5,550	500	21,400	5,300
February	29,600	11,200	300	29,300	350	29,300	10,900	500	29,100	10,700
March	32,700	15,900	200	32,500	300	32,400	15,600	500	32,200	15,400
April	35,200	21,800	200	35,000	300	34,900	21,500	500	34,700	21,300
May	23,600	12,600	300	23,300	400	23,200	12,200	600	23,000	12,000
June	18,500	10,100	300	18,200	400	18,100	9,690	650	17,900	9,440
July	13,600	6,760	400	13,200	500	13,100	6,260	900	12,700	5,860
August	7,990	4,120	320	7,670	470	7,520	3,650	910	7,080	3,210
September	6,890	3,960	280	6,610	380	6,510	3,580	750	6,140	3,210
October	6,920	2,450	250	6,670	340	6,580	2,110	530	6,390	1,920
November	9,580	2,640	240	9,340	330	9,250	2,310	530	9,050	2,110
December	13,500	3,970	250	13,280	350	13,200	3,620	550	13,000	3,420
Annual(e)	219,000	126,000	3,220	216,000	4,400	214,000	121,000	7,500	211,000	118,000

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 505 plus 705 minus 507, 602, and 1011.

TABLE E-4

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE MISSOURI AND
ARKANSAS RIVER BASINS, CONTAINING THE WESTERN INTERIOR, POWDER
RIVER, FORT UNION, AND DENVER-RATON MESA REGIONS

PERIOD	TOTAL STREAM FLOW (b)		1975		1985		2000			
			CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d)	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW (d)	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW (d)		
	MEAN	95%	MEAN	MEAN	MEAN	95%	MEAN	95%	MEAN	95%
January	4,360	1,250	170	4,190	200	4,160	1,050	320	4,040	930
February	5,560	1,720	170	5,390	210	5,350	1,510	320	5,240	1,400
March	7,600	2,620	230	7,370	240	7,360	2,380	370	7,230	2,250
April	10,300	3,320	360	9,940	420	9,880	2,900	550	9,750	2,770
May	11,900	4,680	1,300	10,600	1,600	10,300	3,080	1,600	10,300	3,080
June	13,600	6,730	3,500	10,100	4,090	9,510	2,640	4,030	9,570	2,700
July	13,200	9,760	7,500	5,700	9,020	4,180	740	9,760	3,440	0
August	8,720	8,130	6,420	2,300	8,180	539	-50	8,790	-70	-660
September	6,400	4,230	2,650	3,750	3,490	2,910	740	3,560	2,840	670
October	5,220	2,000	690	4,530	800	4,420	1,200	890	4,330	1,110
November	4,740	1,560	210	4,530	260	4,480	1,300	380	4,360	1,180
December	3,860	1,270	170	3,690	210	3,650	1,060	330	3,530	940
Annual(e)	95,600	51,600	23,500	72,100	28,900	66,700	22,700	31,000	64,600	20,600

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 1011 and 1104.

TABLE E-5

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE LOWER RED,
SABINE, NECHES, TRINITY, BRAZOS, COLORADO, AND NUECES RIVER
BASINS, CONTAINING THE TEXAS COAL REGION

PERIOD	TOTAL STREAM FLOW (b)		1975		1985		2000	
			CONSUMP- TIVE REQUIRE- MENTS (c)	CALCU- LATED FLOW (d) MEAN	CONSUMP- TIVE REQUIRE- ments (c)	CALCULATED FLOW (d) MEAN 95%	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW (d) MEAN 95%
	MEAN	95%						
January	4,740	986	250	4,490	280	4,460 706	450	4,290 536
February	6,280	1,370	350	5,930	310	5,970 1,060	510	5,770 860
March	6,290	1,670	610	5,680	460	5,830 1,210	610	5,680 1,060
April	6,990	1,860	1,080	5,910	820	6,170 1,040	960	6,030 900
May	9,610	2,070	1,110	8,500	1,130	8,480 940	1,300	8,310 770
June	6,960	2,170	2,050	4,910	1,930	5,030 240	2,260	4,700 -90
July	4,440	2,130	2,930	1,510	2,590	1,850 -460	2,580	1,860 -450
August	3,150	2,190	4,030	-878	4,030	-879 -1,840	3,060	93 -870
September	3,010	1,370	1,990	1,020	3,890	876 -2,520	1,830	1,180 -460
October	2,510	511	420	2,090	500	2,010 11	670	1,840 -159
November	2,880	535	340	2,540	350	2,530 185	510	2,370 25
December	3,930	642	220	3,710	280	3,650 362	460	3,470 182
Annual (e)	61,500	23,800	15,500	46,000	14,800	46,700 9,040	15,200	46,300 8,640

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 1201, 1202, 1204, 1205, and 1107.

TABLE E-6

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE
YELLOWSTONE RIVER BASIN CONTAINING THE POWDER
RIVER COAL REGION

PERIOD	TOTAL STREAM FLOW(b)		1975		1985		2000		CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW(d)
	MEAN	95%	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW(d) MEAN	95%	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW(d) MEAN	95%
January	309	171	8	310	12	297	159	16	293	155
February	400	194	8	392	12	387	182	15	384	179
March	672	310	9	663	14	658	296	18	654	292
April	636	322	39	597	108	527	214	124	512	198
May	1,280	820	278	997	320	945	490	294	982	526
June	2,850	1,720	497	2,350	744	2,100	973	685	2,160	1,030
July	2,120	1,200	781	1,340	1,030	1,100	165	993	1,130	202
August	962	684	511	451	798	164	-114	826	136	-142
September	551	321	153	398	383	167	-62	370	181	-49
October	504	317	34	470	132	372	185	135	369	182
November	436	297	8	428	14	422	283	18	418	279
December	328	201	8	320	13	315	188	17	311	184
Annual(e)	11,000	7,260	2,340	8,680	3,590	7,430	3,670	3,510	7,510	3,750

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
The basin is ASR 1004.

TABLE E-7

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE UPPER MISSOURI
RIVER BASIN, CONTAINING THE FORT UNION AND POWDER RIVER COAL REGIONS

PERIOD	TOTAL STREAM FLOW(b)		1975		1985		2000			
			CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d)	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d)		
	MEAN	95%				MEAN	95%		MEAN	95%
January	655	309	25	630	34	621	275	50	606	259
February	554	180	25	530	37	518	143	52	502	128
March	819	323	28	791	42	777	281	59	760	264
April	1,400	641	67	1,330	175	1,230	466	209	1,190	432
May	2,060	1,530	538	1,520	695	1,360	831	791	1,270	735
June	2,480	1,720	965	1,520	1,430	1,050	292	1,540	942	182
July	3,500	2,830	1,730	1,770	2,450	1,050	378	2,940	557	-110
August	3,030	2,280	1,080	1,950	1,960	1,060	318	2,400	627	-121
September	2,210	1,490	323	1,880	932	1,270	556	1,200	1,010	292
October	1,770	925	72	1,700	307	1,460	618	344	1,430	581
November	1,500	511	26	1,470	46	1,450	465	67	1,430	444
December	766	376	25	741	37	729	339	53	713	323
Annual(e)	20,800	12,800	4,900	15,900	8,150	12,600	4,660	9,700	11,100	3,100

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
The basin is ASR 1005.

TABLE E-8

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE GREEN
RIVER BASIN, CONTAINING THE GREEN RIVER COAL REGION

REGION	TOTAL STREAM FLOW(b)		1975		1985		200			
			CONSUMP- TIVE REQUIRE- MENTS (c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW(d) MEAN	95%	CONSUMP- TIVE REQUIRE- MENTS (c)	CALCULATED FLOW(d) MEAN	95%
	MEAN	95%								
January	204	88	12	192	20	183	68	26	178	62
February	250	115	11	239	18	232	97	23	227	92
March	380	123	12	268	20	260	103	25	255	98
April	454	163	23	431	30	424	133	38	416	125
May	896	518	145	751	158	738	360	169	727	349
June	1,210	667	294	914	334	873	333	357	853	310
July	721	442	360	361	370	351	72	405	316	37
August	374	256	169	204	297	77	-41	333	41	-77
September	261	179	75	187	146	115	33	169	92	10
October	215	93	17	198	33	182	60	42	173	51
November	204	105	12	192	23	181	82	29	175	76
December	199	82	12	187	22	177	60	28	171	54
Annual(e)	5,260	3,100	1,140	4,120	1,470	3,790	1,630	1,640	3,620	1,460

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
The basin is ASR 1401.

TABLE E-9

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE UPPER COLORADO
MAINSTREAM AND GREEN RIVER BASINS, CONTAINING THE UINTA - SOUTH -
WESTERN UTAH AND GREEN RIVER - HAMS FORK COAL REGIONS

REGION	TOTAL STREAM FLOW(b)		1975		1985		2000			
			CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d) MEAN	95%	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d) MEAN	95%
	MEAN	95%								
January	376	243	16	360	25	351	218	35	341	208
February	434	283	16	418	23	410	260	33	401	250
March	491	312	16	475	24	467	288	35	457	277
April	976	573	30	946	40	936	533	63	913	510
May	2,280	1,690	306	1,970	316	1,960	1,370	350	1,930	1,340
June	2,890	2,080	598	2,300	633	2,260	1,450	671	2,220	1,410
July	1,540	1,120	661	876	660	8,770	460	695	842	425
August	822	649	377	445	509	313	140	540	282	109
September	568	440	168	399	305	262	135	327	241	113
October	445	284	24	422	37	408	247	51	394	233
November	421	305	16	405	28	394	277	39	383	266
December	387	248	16	371	26	361	222	37	351	211
Annual(e)	11,700	6,560	2,250	9,430	2,630	9,050	3,930	2,880	8,800	3,680

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 1401 and 1402.

TABLE E-10

CALCULATED PRESENT AND FUTURE WATER FLOW IN THE UPPER
COLORADO RIVER BASIN, CONTAINING THE GREEN RIVER - HAMS
FORK, UINTA - SOUTHWESTERN AND SAN JUAN RIVER COAL REGIONS

PERIOD	TOTAL STREAM FLOW(b)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d) MEAN	CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW(d)	
	MEAN	95%				MEAN	95%		MEAN	95%
January	748	172	21	728	36	712	136	48	700	124
February	778	511	20	758	34	744	477	46	732	465
March	816	379	22	794	37	778	342	50	766	329
April	1,310	247	47	1,260	71	1,240	176	101	1,210	146
May	1,650	536	366	1,290	422	1,230	114	465	1,190	71
June	2,010	863	736	1,270	847	1,160	16	930	1,080	-67
July	1,740	907	792	942	893	842	14	950	785	-43
August	1,420	593	447	970	698	720	-105	746	672	-153
September	1,140	357	206	933	411	729	-54	444	695	-87
October	723	194	31	691	63	659	131	77	646	117
November	791	206	31	770	40	752	166	53	738	153
December	815	184	21	794	39	777	145	52	764	132
Annual(e)	13,900	7,100	2,730	11,200	3,590	10,300	3,510	3,960	9,970	3,170

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
The basin is ASR 1403.

TABLE E-11

CALCULATED PRESENT AND FUTURE WATER FLOW(S) IN THE UPPER ARKANSAS AND
UPPER PLATTE RIVER BASINS, CONTAINING THE DENVER-RATON MESA COAL REGION

PERIOD	1975					1985			2000		
	TOTAL STREAM FLOW (b)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCU- LATED FLOW(d)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW (d)		CONSUMP- TIVE REQUIRE- MENTS(c)	CALCULATED FLOW (d)	
	MEAN	95%		MEAN	95%		MEAN	95%		MEAN	95%
January	122	80	25	97	55	28	94	52	44	78	36
February	139	192	26	114	66	29	110	63	45	94	47
March	141	89	29	113	60	18	123	71	35	106	54
April	138	82	29	108	53	35	103	47	53	85	29
May	352	244	234	118	10	169	183	75	110	242	134
June	1070	905	996	72	-91	778	290	127	662	408	243
July	1450	1380	1550	-103	-172	1480	-35	-100	1650	-203	-270
August	1070	1020	1150	-76	-127	1180	-109	-157	1320	-248	-300
September	430	370	393	37	-23	412	18	-42	468	-38	-98
October	169	113	64	105	49	41	118	72	68	101	45
November	139	96	26	113	70	31	108	65	49	90	47
December	128	92	26	102	66	29	99	63	47	81	45
Annual(d)	5350	5240	4540	805	696	4240	1104	1000	4550	800	690

Note: All flows in 1000s of acre-feet.
Footnotes are presented in Table E-12.
Basins are ASR 1007 and 1102.

TABLE E-12

FOOTNOTES FOR WATER FLOW PREVENTIONS IN TABLES E-2 to E-10.

- (a) Total Stream Flow is an estimate of the stream flow that would be observed without any upstream consumption or groundwater mining, but with evaporation, imports, and exports continuing as at present. It is computed for the discharge point of the aggregated sub-region (ASR most closely corresponding to the coal region). The 95% flow represents a low flow that is likely to occur during 5 out of 100 years (or months).
- (b) Consumptive surface water requirements are the projected water requirements for all areas upstream of the discharge point(s) of the ASR(s), including estimated increased evaporation from new impoundments and any changes in inter-basin exports. The actual amount of water consumed during a particular year may be less than the indicated requirements due to such factors as insufficient supplies at specific points within the region, unavailability of water of sufficient quality, and operator error or mechanical failure during diversion. Additionally, during periods of below-normal rainfall, irrigation demands could be greater than those projected.
- (c) Calculated Flow is the difference between total stream flow and the consumptive requirements for both average and low flow conditions. The calculated flow for 1975 is the estimated current stream flow (as adjusted by the WRC) minus the estimated contribution of groundwater mining. Negative flows indicated water shortages that would have to be borne by water users. Positive flows do not necessarily imply that the water is available for use. The actual availability depends on such factors as minimum in-stream requirements, water quality, and water law as determined by each state and by compacts between the states (see text).
- (d) Annual totals may not equal the sum of the individual months due to accumulated round-off error.

SOURCE: Adapted from U. S. Water Resources Council, 1978. Preliminary Review Copy, the Nation's Water Resources--the Second National Water Assessment, Washington, D.C.

APPENDIX F

REGIONAL COAL PRODUCTION AND USE SUMMARIES

TABLE F-1

REGIONAL COAL PRODUCTION AND USE SUMMARY^(a)
 1976 BASE YEAR
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	875.8	437.5	420.3	645.9	413.4	-	-	-	232.5	307.0
Ohio	465.8	167.7	298.1	709.6	581.9	-	-	-	127.7	232.3
Maryland	28.3	1.7	26.6	91.9	48.7	-	-	-	43.2	22.3
West Virginia	407.7	313.9	93.8	182.4	129.5	-	-	-	52.9	133.5
Northern Appalachian TOTAL	1759.6	920.9	838.8	1629.8	1173.5	-	-	-	456.3	695.1
West Virginia	680.7	558.1	122.5	182.4	182.4	-	-	-	-	182.7
Virginia	400.0	264.0	136.0	74.7	74.7	-	-	-	-	91.7
Kentucky	911.4	401.0	510.4	74.2	66.0	-	-	-	8.2	170.9
Tennessee	76.2	32.0	44.2	175.4	173.6	-	-	-	1.8	50.6
Central Appalachian TOTAL	2068.3	1255.1	813.1	506.7	496.7	-	-	-	10.0	495.9
Tennessee	16.7	12.0	4.7	55.5	55.5	-	-	-	-	18.1
Georgia	1.9	-	1.9	150.7	150.7	-	-	-	-	34.2
Alabama	215.4	73.2	142.1	259.8	192.3	-	-	-	67.6	101.1
Southern Appalachian TOTAL	234.0	85.2	148.7	466.0	398.5	-	-	-	67.6	153.4
Iowa	-	-	-	-	-	-	-	-	-	-
Illinois	582.4	308.7	273.7	414.6	385.5	-	-	-	29.0	197.1
Indiana	253.7	5.1	248.6	458.4	334.6	-	-	-	123.8	134.9
Kentucky	258.3	237.8	290.6	199.0	199.0	-	-	-	-	111.6
Eastern Interior TOTAL	1364.4	551.6	812.9	1072.0	919.1	-	-	-	152.8	443.6
Missouri	60.8	-	60.8	228.0	225.7	-	-	-	2.3	61.8
Arkansas	5.3	0.3	5.0	0.3	0.3	-	-	-	-	1.2
Oklahoma	36.4	-	36.4	6.6	6.6	-	-	-	-	6.9
Kansas	5.9	-	5.9	34.8	34.8	-	-	-	-	9.8
Nebraska	-	-	-	22.7	22.7	-	-	-	-	14.8
Iowa	6.2	3.1	3.1	78.9	78.9	-	-	-	-	20.3
Western Interior TOTAL	114.6	3.4	111.2	371.3	369.0	-	-	-	2.3	114.8
Texas	140.6	-	140.6	164.2	157.6	-	-	-	6.6	59.7
Louisiana	-	-	-	-	-	-	-	-	-	-
Arkansas	-	-	-	1.2	1.2	-	-	-	-	1.4
Texas TOTAL	140.6	-	140.6	165.4	158.8	-	-	-	6.6	61.1

TABLE F-1

REGIONAL COAL PRODUCTION AND USE SUMMARY (a)
 1976 BASE YEAR
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	259.2	-	259.2	13.4	13.4	-	-	-	-	29.6
Wyoming	114.9	-	114.9	48.9	48.9	-	-	-	-	23.1
Powder River TOTAL	374.1	-	374.1	62.3	62.3	-	-	-	-	52.7
Montana	3.1	-	3.1	12.3	12.3	-	-	-	-	4.4
North Dakota	111.0	-	111.0	75.0	75.0	-	-	-	-	28.7
South Dakota	-	-	-	28.6	28.6	-	-	-	-	7.1
Fort Union TOTAL	114.1	-	114.1	115.9	115.9	-	-	-	-	40.2
Wyoming	193.5	-	193.5	48.9	48.9	-	-	-	-	29.8
Colorado	63.4	3.8	59.6	31.0	31.0	-	-	-	-	13.7
Idaho	-	-	-	6.1	6.1	-	-	-	-	2.0
Utah	-	-	-	0.3	0.3	-	-	-	-	0.2
Green River-Basin Fork TOTAL	256.9	3.8	253.1	86.3	86.3	-	-	-	-	45.7
Colorado	8.1	7.3	.8	52.0	41.1	-	-	-	10.9	17.6
New Mexico	10.5	7.3	3.2	0.2	0.2	-	-	-	-	2.7
Denver-Raton Mesa TOTAL	18.6	14.6	4.0	52.2	41.3	-	-	-	10.9	20.3
Colorado	21.8	21.8	-	5.0	5.0	-	-	-	-	5.2
Utah	79.7	79.7	-	44.1	24.7	-	-	-	19.4	25.8
Uinta-Southwestern Utah TOTAL	101.5	101.5	-	49.1	29.7	-	-	-	19.4	31.0
New Mexico	87.1	-	87.1	80.8	80.8	-	-	-	-	27.4
Colorado	1.2	0.2	1.0	4.0	4.0	-	-	-	-	1.0
Utah	-	-	-	0.5	0.5	-	-	-	-	0.1
San Juan River TOTAL	88.3	0.2	88.1	85.3	85.3	-	-	-	-	28.5

TABLE F-1

REGIONAL COAL PRODUCTION AND USE SUMMARY (a)
1976 BASE YEAR
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	104.2	-	104.2	70.7	70.7	-	-	-	-	27.0
California	-	-	-	25.3	6.3	-	-	-	18.9	4.8
Nevada	-	-	-	51.6	51.6	-	-	-	-	11.5
Oregon/Washington	-	-	-	49.4	49.4	-	-	-	-	10.8
Other West SUBTOTAL	104.2	-	104.2	197.0	178.0	-	-	-	18.9	54.1
Connecticut/Rhode Island/Massachusetts	-	-	-	0.9	0.9	-	-	-	-	0.3
Delaware/New Jersey	-	-	-	32.8	32.8	-	-	-	-	7.5
Florida	-	-	-	61.1	61.1	-	-	-	-	13.8
Maine/New Hampshire/Vermont	-	-	-	8.4	8.4	-	-	-	-	1.9
Michigan	-	-	-	298.1	253.3	-	-	-	44.7	62.4
Minnesota/Wisconsin	-	-	-	258.9	248.6	-	-	-	10.4	58.1
Mississippi	-	-	-	16.7	16.7	-	-	-	-	3.9
New York	-	-	-	135.6	84.1	-	-	-	51.5	26.4
North Carolina/South Carolina	-	-	-	279.8	279.8	-	-	-	-	62.3
Other East SUBTOTAL	-	-	-	1092.3	985.7	-	-	-	106.6	236.6
OTHER U.S. - TOTALS	104.2	-	104.2	1289.3	1163.0	-	-	-	125.5	290.7
EASTERN U.S. TOTALS	5681.5	2816.2	2865.3	4211.2	3515.6	-	-	-	695.6	1963.9
WESTERN U.S. TOTALS	953.5	120.1	833.4	451.1	420.8	-	-	-	30.3	218.4
U.S. TOTALS	6739.2	2936.3	3802.9	5951.6	5100.0	-	-	-	851.4	2473.0

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-2

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PREFERRED PROGRAM ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL^(a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,294.0	918.7	375.3	821.0	501.6	--	--	--	319.4	466.7
Ohio	420.0	239.4	180.6	729.0	577.4	--	--	--	151.6	243.1
Maryland	33.0	22.4	10.6	103.0	53.7	--	--	--	49.3	28.6
West Virginia	369.0	287.8	81.2	176.0	111.6	--	--	--	64.4	123.9
Northern Appalachian TOTAL	2,116.0	1,468.3	647.7	1,829.0	1,244.3	--	--	--	584.7	862.3
West Virginia	907.0	707.5	199.5	201.0	201.0	--	--	--	--	233.3
Virginia	216.0	155.5	60.5	136.0	136.0	--	--	--	--	74.4
Kentucky	909.0	609.0	300.0	83.0	83.0	--	--	--	--	191.4
Tennessee	12.0	5.0	7.0	140.0	138.6	--	--	--	1.4	33.0
Central Appalachian TOTAL	2,044.0	1,477.0	567.0	560.0	558.6	--	--	--	1.4	532.1
Tennessee	16.0	4.6	11.4	73.0	73.0	--	--	--	--	22.4
Georgia	--	--	--	466.0	466.0	--	--	--	--	103.5
Alabama	250.0	135.0	115.0	500.0	425.0	--	--	--	75.0	168.6
Southern Appalachian TOTAL	266.0	139.6	126.4	1,039.0	964.0	--	--	--	75.0	294.5
Iowa	--	--	--	74.0	74.0	--	--	--	--	16.2
Illinois	1,278.0	1,009.6	268.4	469.0	417.4	--	12.2	--	39.4	350.0
Indiana	350.0	171.5	178.5	656.0	495.9	--	--	--	160.1	201.5
Kentucky	469.0	253.3	215.7	342.0	315.7	--	--	11.6	14.7	153.5
Eastern Interior TOTAL	2,097.0	1,434.4	662.6	1,541.0	1,303.0	--	12.2	11.6	214.2	721.2
Missouri	74.0	28.1	45.8	291.0	291.0	--	--	--	--	80.5
Arkansas	13.0	8.3	4.7	368.0	368.0	--	--	--	--	82.9
Oklahoma	27.0	6.5	20.5	25.0	25.0	--	--	--	--	10.0
Kansas	7.0	--	7.0	19.0	19.0	--	--	--	--	8.0
Nebraska	--	--	--	201.0	201.0	--	--	--	--	60.4
Iowa	15.0	9.0	6.0	122.0	119.3	--	--	--	2.7	32.2
Western Interior TOTAL	136.0	51.9	84.0	1,026.0	1,023.3	--	--	--	2.7	274.0
Texas	663.0	--	663.0	1,228.0	1,194.8	--	17.2	--	16.0	343.6
Louisiana	--	--	--	11.0	11.0	--	--	--	--	2.5
Arkansas	--	--	--	144.0	144.0	--	--	--	--	33.3
Texas TOTAL	663.0	--	663.0	1,383.0	1,349.8	--	17.2	--	16.0	379.4

TABLE F-2

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PREFERRED PROGRAM ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	866.0	--	866.0	127.0	127.0	--	--	--	--	111.5
Wyoming	1,184.0	--	1,184.0	39.0	39.0	--	--	--	--	115.2
Powder River TOTAL	2,050.0	--	2,050.0	166.0	166.0	--	--	--	--	226.7
Montana	5.0	--	5.0	7.0	7.0	--	--	--	--	4.4
North Dakota	295.0	--	295.0	145.0	57.0	88.0	--	--	--	54.7
South Dakota	19.0	--	19.0	69.0	69.0	--	--	--	--	17.2
Fort Union TOTAL	319.0	--	319.0	221.0	133.0	88.0	--	--	--	76.3
Wyoming	651.0	--	651.0	29.0	29.0	--	--	--	--	65.9
Colorado	149.0	38.7	110.3	1.0	1.0	--	--	--	--	19.8
Idaho	--	--	--	145.0	145.0	--	--	--	--	32.8
Utah	--	--	--	10.0	10.0	--	--	--	--	2.4
Green River--Hams Fork TOTAL	800.0	38.7	761.3	185.0	185.0	--	--	--	--	120.9
Colorado	33.0	11.2	21.8	197.0	180.5	--	--	--	16.5	55.5
New Mexico	17.0	17.0	--	14.0	14.0	--	--	--	--	8.0
Denver-Raton Mesa TOTAL	50.0	28.2	21.8	211.0	194.5	--	--	--	16.5	63.5
Colorado	49.0	28.4	21.1	2.0	2.0	--	--	--	--	8.0
Utah	251.0	223.4	27.6	181.0	169.1	--	--	--	11.9	88.6
Uinta-Southwestern TOTAL	300.0	251.8	48.7	183.0	171.1	--	--	--	11.9	96.6
New Mexico	230.0	4.6	225.4	80.0	80.0	--	--	--	--	42.5
Colorado	20.0	9.0	11.0	1.0	1.0	--	--	--	--	3.1
Utah	--	--	--	8.0	8.0	--	--	--	--	1.8
San Juan River TOTAL	250.0	13.6	236.4	89.0	89.0	--	--	--	--	47.4

TABLE F-2

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PREFERRED PROGRAM ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	30.0	--	30.0	201.0	125.4	75.6	--	--	--	44.7
California	--	--	--	70.0	51.0	--	--	--	18.9	14.9
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.8
Oregon/Washington	--	--	--	51.0	51.0	--	--	--	--	11.3
Other West	30.0	--	30.0	333.0	238.4	75.6	--	--	18.9	73.7
CONNECTICUT/RHODE ISLAND/MASSACHUSETTS	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	101.0	101.0	--	--	--	--	22.9
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	349.0	292.8	--	--	--	56.2	73.0
Minnesota/Wisconsin	--	--	--	441.0	386.8	--	--	--	54.2	96.5
Mississippi	--	--	--	18.0	18.0	--	--	--	--	4.4
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/South Carolina	--	--	--	346.0	346.0	--	--	--	--	77.6
Other East	--	--	--	1,561.0	1,355.9	--	--	--	205.1	336.0
OTHER U.S. - TOTALS	30.0	--	30.0	1,894.0	1,594.3	75.6	--	--	224.0	409.7
EASTERN U.S. TOTALS	7,322.0	4,571.2	2,750.7	7,378.0	6,443.0	--	29.4	11.6	894.0	3,063.5
WESTERN U.S. TOTALS	3,769.0	332.3	3,437.2	1,055.0	938.6	88.0	--	--	28.4	631.4
U.S. TOTALS	11,121.0	9,903.5	6,217.9	10,327.0	8,975.9	163.6	29.4	11.6	1,146.4	4,104.6

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-3

REGIONAL COAL PRODUCTION AND USE SUMMARIES
PREFERRED PROGRAM ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,137.0	858.8	284.2	884.0	591.4	--	19.4	--	273.2	463.4
Ohio	341.0	245.5	95.5	870.0	656.0	--	53.1	--	160.9	265.7
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.1
West Virginia	636.0	572.4	63.6	240.0	166.3	--	--	--	73.4	210.9
Northern Appalachian TOTAL	2,201.0	1,736.8	464.2	2,103.0	1,480.2	--	72.5	--	550.0	983.1
West Virginia	821.0	673.2	147.8	133.0	133.0	--	--	--	--	206.4
Virginia	309.0	234.8	74.2	147.0	147.0	--	--	--	--	96.8
Kentucky	925.0	684.5	240.5	108.0	108.0	--	--	--	--	208.3
Tennessee	7.0	3.9	3.1	459.0	457.6	--	--	--	1.4	102.1
Central Appalachian TOTAL	2,062.0	1,596.4	465.6	847.0	845.6	--	--	--	1.4	613.6
Tennessee	4.0	2.0	2.0	91.0	89.7	--	--	--	1.3	25.4
Georgia	--	--	--	589.0	589.4	--	--	--	--	130.1
Alabama	250.0	162.5	87.5	500.0	398.5	--	11.0	--	90.5	172.8
Southern Appalachian TOTAL	254.0	164.5	89.5	1,180.0	1,077.2	--	11.0	--	91.8	328.3
Iowa	--	--	--	29.0	28.5	--	--	--	0.5	6.3
Illinois	2,307.0	2,076.3	230.7	510.0	442.2	--	25.5	--	42.3	567.8
Indiana	338.0	256.9	81.1	707.0	514.0	--	22.6	--	170.4	216.1
Kentucky	552.0	353.3	198.7	498.0	422.8	--	--	59.8	15.4	203.9
Eastern Interior TOTAL	3,197.0	2,686.5	510.5	1,744.0	1,407.5	--	48.1	59.8	228.6	994.1
Missouri	105.0	69.3	35.7	279.0	279.0	--	--	--	--	85.1
Arkansas	17.0	13.4	3.6	907.0	888.9	--	18.1	--	--	200.2
Oklahoma	33.0	14.8	18.2	53.0	53.0	--	--	--	--	17.3
Kansas	4.0	--	4.0	67.0	54.4	--	12.6	--	--	18.2
Nebraska	--	--	--	247.0	247.0	--	--	--	--	77.1
Iowa	12.0	8.4	3.6	198.0	194.8	--	--	--	3.2	49.8
Western Interior TOTAL	171.0	105.9	65.1	1,751.0	1,717.1	--	30.7	--	3.2	447.7
Texas	861.0	--	861.0	2,281.0	2,249.1	--	18.2	--	13.7	598.8
Louisiana	--	--	--	21.0	21.0	--	--	--	--	4.7
Arkansas	--	--	--	211.0	211.0	--	--	--	--	48.7
Texas TOTAL	861.0	--	861.0	2,513.0	2,481.1	--	18.2	--	13.7	652.2

TABLE F-3

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PREFERRED PROGRAM ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	2,068.0	--	2,068.0	198.0	112.5	--	85.5	--	--	232.5
Wyoming	1,932.0	--	1,932.0	78.0	15.8	62.2	--	--	--	186.1
Powder River TOTAL	4,000.0	--	4,000.0	276.0	128.3	62.2	85.5	--	--	418.6
Montana	5.0	--	5.0	19.0	2.1	--	16.9	--	--	6.9
North Dakota	395.0	--	395.0	286.0	204.5	81.5	--	--	--	96.1
South Dakota	19.0	--	19.0	135.0	135.0	--	--	--	--	32.2
Fort Union TOTAL	419.0	--	419.0	440.0	341.6	81.5	16.9	--	--	135.2
Wyoming	996.0	--	996.0	92.0	29.7	62.3	--	--	--	106.8
Colorado	204.0	81.6	122.4	1.0	1.0	--	--	--	--	30.3
Idaho	--	--	--	99.0	99.0	--	--	--	--	23.3
Utah	--	--	--	9.0	9.0	--	--	--	--	2.3
Green River-Horns Fork TOTAL	1,200.0	81.6	1,118.4	201.0	137.7	62.3	--	--	--	162.7
Colorado	65.0	31.9	33.6	295.0	270.2	--	--	--	24.8	94.0
New Mexico	35.0	35.0	--	8.0	8.0	--	--	--	--	11.1
Denver-Raton Mesa TOTAL	100.0	66.9	33.6	303.0	278.2	--	--	--	24.8	105.1
Colorado	109.0	88.3	20.7	1.0	1.0	--	--	--	--	24.5
Utah	291.0	256.1	34.9	217.0	191.4	--	--	--	25.8	104.2
Uinta-Southwestern Utah TOTAL	400.0	344.4	55.6	218.0	192.4	--	--	--	25.8	128.7
New Mexico	479.0	4.8	474.2	126.0	69.4	56.6	--	--	--	74.2
Colorado	21.0	12.4	8.6	1.0	1.0	--	--	--	--	14.4
Utah	--	--	--	9.0	9.0	9.0	--	--	--	2.0
San Juan River TOTAL	500.0	17.2	482.8	136.0	79.4	65.6	--	--	--	90.6

TABLE F-3

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PREFERRED PROGRAM ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	107.0	--	107.0	282.0	208.4	73.9	--	--	--	71.0
California	--	--	--	139.0	111.2	--	--	--	27.8	29.7
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.9
Oregon/Washington	--	--	--	274.0	274.0	--	--	--	--	60.0
Other West	107.0	--	107.0	706.0	604.6	73.9	--	--	27.8	163.3
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	350.0	350.0	--	--	--	--	77.6
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	539.0	471.1	--	--	--	67.9	113.9
Minnesota/Wisconsin	--	--	--	331.0	310.8	--	--	--	20.2	76.3
Mississippi	--	--	--	24.0	24.0	--	--	--	--	5.9
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	213.0	213.0	--	--	--	--	49.4
Other East	--	--	--	2,067.0	1,865.1	--	--	--	201.9	450.3
SUBTOTAL										
OTHER U.S. - TOTALS	107.0	--	107.0	2,773.0	2,469.7	73.9	--	--	229.7	613.9
EASTERN U.S. TOTALS	8,746.0	6,290.1	2,455.9	10,138.0	9,008.7	--	180.5	59.8	888.7	4,019.0
WESTERN U.S. TOTALS	6,619.0	510.1	6,109.4	1,574.0	1,157.6	271.6	102.4	--	50.6	1,040.9
U.S. TOTALS	15,472.0	6,800.2	8,672.3	14,485.0	12,636.0	345.5	282.9	59.8	1,169.0	5,673.8

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-4
REGIONAL COAL PRODUCTION AND USE SUMMARY
NO NEW LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,295.0	919.4	375.6	821.0	501.6	--	--	--	319.4	467.0
Ohio	421.0	240.0	181.0	729.0	577.4	--	--	--	151.6	243.3
Maryland	33.0	22.4	10.6	103.0	53.7	--	--	--	49.3	28.6
West Virginia	368.0	287.0	81.0	176.0	111.6	--	--	--	64.4	123.7
Northern Appalachian TOTAL	2,117.0	1,468.8	648.2	1,829.0	1,244.3	--	--	--	584.7	862.6
West Virginia	906.0	706.7	199.3	201.0	201.0	--	--	--	--	233.1
Virginia	212.0	152.6	59.4	136.0	136.0	--	--	--	--	73.7
Kentucky	925.0	619.8	305.2	85.0	85.0	--	--	--	--	194.8
Tennessee	12.0	5.0	7.0	142.0	140.6	--	--	--	1.4	33.4
Central Appalachian TOTAL	2,055.0	1,484.1	570.9	564.0	562.6	--	--	--	1.4	535.0
Tennessee	15.0	4.4	10.6	75.0	75.0	--	--	--	--	22.6
Georgia	--	--	--	469.0	469.0	--	--	--	--	104.2
Alabama	260.0	140.0	119.6	516.0	438.6	--	--	--	77.4	174.3
Southern Appalachian TOTAL	275.0	144.4	130.2	1,060.0	982.6	--	--	--	77.4	301.1
Iowa	--	--	--	75.0	75.0	--	--	--	--	16.4
Illinois	1,272.0	1,004.9	267.1	468.0	416.5	--	12.2	--	39.3	348.6
Indiana	345.0	169.0	176.0	657.0	496.7	--	--	--	160.3	200.8
Kentucky	444.0	239.8	204.2	344.0	317.5	--	--	11.7	14.8	150.1
Eastern Interior TOTAL	2,061.0	1,413.7	647.3	1,544.0	1,305.7	--	12.2	11.7	214.4	715.9
Missouri	74.0	28.1	45.9	297.0	297.0	--	--	--	--	81.8
Arkansas	15.0	9.6	5.4	423.0	423.0	--	--	--	--	95.2
Oklahoma	30.0	7.2	22.8	17.0	17.0	--	--	--	--	8.6
Kansas	8.0	--	8.0	18.0	18.0	--	--	--	--	7.9
Nebraska	--	--	--	195.0	195.0	--	--	--	--	59.1
Iowa	15.0	9.0	6.0	119.0	116.4	--	--	--	2.6	31.5
Western Interior TOTAL	142.0	53.9	88.1	1,069.0	1,066.4	--	--	--	2.6	284.1
Texas	640.0	--	640.0	1,208.0	1,175.4	--	16.9	--	15.7	337.9
Louisiana	--	--	--	13.0	13.0	--	--	--	--	2.9
Arkansas	--	--	--	156.0	156.0	--	--	--	--	35.9
Texas TOTAL	640.0	--	640.0	1,377.0	1,344.4	--	16.9	--	15.7	376.7

TABLE F-4

REGIONAL COAL PRODUCTION AND USE SUMMARY
 NO NEW LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	648.0	--	648.0	129.0	129.0	--	--	--	--	92.1
Wyoming	1,400.0	--	1,400.0	37.0	37.0	--	--	--	--	133.5
Powder River TOTAL	2,048.0	--	2,048.0	166.0	166.0	--	--	--	--	225.6
Montana	5.0	--	5.0	7.0	7.0	--	--	--	--	4.4
North Dakota	295.0	--	295.0	145.0	57.0	88.0	--	--	--	54.7
South Dakota	19.0	--	19.0	46.0	46.0	--	--	--	--	12.2
Fort Union TOTAL	319.0	--	319.0	198.0	110.0	88.0	--	--	--	71.3
Wyoming	623.0	--	623.0	28.0	28.0	--	--	--	--	63.3
Colorado	137.0	35.6	101.4	1.0	1.0	--	--	--	--	18.2
Idaho	--	--	--	141.0	141.0	--	--	--	--	32.0
Utah	--	--	--	10.0	10.0	--	--	--	--	2.4
Green River-Hueco Fork TOTAL	760.0	35.6	724.4	180.0	180.0	--	--	--	--	115.9
Colorado	33.0	11.2	21.8	187.0	171.3	--	--	--	15.7	53.4
New Mexico	17.0	17.0	--	14.0	14.0	--	--	--	--	8.0
Denver-Raton Mesa TOTAL	50.0	29.2	21.8	201.0	185.3	--	--	--	15.7	61.4
Colorado	45.0	26.1	18.9	2.0	2.0	--	--	--	--	7.4
Utah	251.0	223.4	27.6	176.0	164.4	--	--	--	11.6	87.6
Uinta-Southwestern Utah TOTAL	296.0	249.5	46.5	178.0	166.4	--	--	--	11.6	95.0
New Mexico	230.0	4.6	225.4	80.0	80.0	--	--	--	--	1.8
Colorado	18.0	8.1	9.9	1.0	1.0	--	--	--	--	2.8
Utah	--	--	--	8.0	8.0	--	--	--	--	42.5
San Juan River TOTAL	248.0	12.7	235.3	89.0	89.0	--	--	--	--	47.1

TABLE F-4

REGIONAL COAL PRODUCTION AND USE SUMMARY
 NO NEW LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	42.0	--	42.0	203.0	126.7	76.3	--	--	--	46.3
California	--	--	--	70.0	51.1	--	--	--	--	14.9
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.8
Oregon/Washington	--	--	--	48.0	48.0	--	--	--	--	10.6
Other West	42.0	--	42.0	332.0	236.8	76.3	--	--	--	74.6
Connecticut/Rhode Island/Massachusetts	--	--	--	58.0	58.0	--	--	--	--	+2.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	102.0	102.0	--	--	--	--	23.1
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	344.0	288.6	--	--	--	--	71.9
Minnesota/Wisconsin	--	--	--	429.0	376.2	--	--	--	--	93.9
Mississippi	--	--	--	20.0	20.0	--	--	--	--	4.8
New York	--	--	--	204.0	109.3	--	--	--	--	38.5
North Carolina/South Carolina	--	--	--	346.0	346.0	--	--	--	--	77.6
Other East	--	--	--	1,547.0	1,344.1	--	--	--	--	332.9
OTHER U.S. - TOTALS	42.0	--	42.0	1,879.0	1,580.9	76.3	--	--	--	407.5
EASTERN U.S. TOTALS	7,290.0	4,564.9	2,724.7	7,443.0	6,506.0	--	29.1	11.7	896.2	3075.4
WESTERN U.S. TOTALS	3,721.0	327.0	3,395.0	1,012.0	896.7	88.0	--	--	27.3	616.3
U.S. TOTALS	11,053.0	4,891.9	6,161.7	10,334.0	8,983.6	164.3	29.1	11.7	1145.3	4099.2

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-5

REGIONAL COAL PRODUCTION AND USE SUMMARY
 NO NEW LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,130.0	849.8	283.3	884.0	591.4	--	19.5	--	273.2	462.1
Ohio	341.0	245.5	95.5	868.0	654.5	--	52.9	--	160.6	265.1
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.1
West Virginia	636.0	572.4	63.6	240.0	166.3	--	--	--	73.7	210.9
Northern Appalachian TOTAL	2,194.0	1,733.8	463.3	2,101.0	1,478.7	--	72.4	--	550.0	981.2
West Virginia	820.0	672.4	147.6	133.0	133.0	--	--	--	--	206.1
Virginia	310.0	235.6	74.4	147.0	147.0	--	--	--	--	96.9
Kentucky	974.0	720.8	253.2	108.0	108.0	--	--	--	--	217.2
Tennessee	8.0	4.5	3.5	459.0	457.6	--	--	--	1.4	102.3
Central Appalachian TOTAL	2,112.4	1,633.3	478.7	847.0	845.6	--	--	--	1.4	622.5
Tennessee	4.0	2.0	2.0	91.0	89.7	--	--	--	1.3	25.3
Georgia	--	--	--	589.0	589.0	--	--	--	--	131.0
Alabama	260.0	169.0	91.0	500.0	398.5	--	11.0	--	90.5	175.1
Southern Appalachian TOTAL	264.0	171.0	93.0	1,180.0	1,077.2	--	11.0	--	93.2	331.4
Iowa	--	--	--	29.0	28.5	--	--	--	0.5	6.3
Illinois	2,367.0	2,130.7	236.7	510.0	442.2	--	25.5	--	42.3	579.2
Indiana	329.0	250.0	79.0	707.0	514.0	--	22.6	--	170.4	214.3
Kentucky	619.0	396.2	222.8	498.0	472.8	--	--	59.8	15.4	214.4
Eastern Interior TOTAL	3,315.0	2,776.9	538.5	1,744.0	1,457.5	--	48.1	59.8	228.6	1,014.2
Missouri	162.0	106.9	55.1	27.0	279.0	--	--	--	--	92.4
Arkansas	23.0	18.2	4.8	907.0	888.9	--	18.1	--	--	201.1
Oklahoma	50.0	22.5	27.5	53.0	53.0	--	--	--	--	19.6
Kansas	5.0	--	5.0	67.0	54.4	--	12.6	--	--	18.3
Nebraska	--	--	--	247.0	247.0	--	--	--	--	76.8
Iowa	15.0	10.5	4.5	198.0	194.8	--	--	--	3.2	50.2
Western Interior TOTAL	255.0	158.1	96.9	1,751.0	1,717.1	--	30.7	--	3.2	458.4
Texas	1,194.0	--	1,194.0	2,281.0	2,249.1	--	18.2	--	13.7	627.4
Louisiana	--	--	--	21.0	21.0	--	--	--	--	4.7
Arkansas	--	--	--	211.0	211.0	--	--	--	--	48.7
Texas TOTAL	1,194.0	--	1,194.0	2,513.0	2,481.1	--	18.2	--	13.7	680.8

TABLE F-5

REGIONAL COAL PRODUCTION AND USE SUMMARY
 NO NEW LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	1,100.0	--	1,100.0	198.0	112.5	--	85.5	--	--	144.7
Wyoming	1,950.0	--	1,950.0	78.0	15.8	62.2	--	--	--	187.6
Powder River TOTAL	3,050.0	--	3,050.0	276.0	128.3	62.2	85.5	--	--	332.3
Montana	7.0	--	7.0	19.0	2.1	--	16.9	--	--	7.3
North Dakota	484.0	--	484.0	286.0	204.5	81.5	--	--	--	102.5
South Dakota	19.0	--	19.0	135.0	135.0	--	--	--	--	32.2
Fort Union TOTAL	510.0	--	510.0	440.0	341.6	81.5	16.9	--	--	142.0
Wyoming	800.0	--	800.0	92.0	29.7	62.3	--	--	--	89.8
Colorado	187.0	74.8	112.2	1.0	1.0	--	--	--	--	27.7
Idaho	--	--	--	99.0	99.0	--	--	--	--	23.3
Utah	--	--	--	9.0	9.0	--	--	--	--	2.3
Green River- Fork TOTAL	987.0	74.8	912.2	201.0	138.7	62.3	--	--	--	143.1
Colorado	65.0	31.9	33.2	295.0	270.2	--	--	--	24.8	92.9
New Mexico	42.0	42.0	--	8.0	8.0	--	--	--	--	12.7
Denver-Raton Mesa TOTAL	107.0	73.9	33.2	303.0	278.2	--	--	--	24.8	105.6
Colorado	100.0	81.0	19.0	1.0	1.0	--	--	--	--	22.3
Utah	350.0	308.0	42.0	217.0	191.4	--	--	--	25.8	115.0
Uinta-Southwestern Utah TOTAL	450.0	389.0	61.0	218.0	192.4	--	--	--	25.8	137.3
New Mexico	575.0	5.8	569.3	126.0	69.4	56.6	--	--	--	83.7
Colorado	19.0	11.2	7.8	1.0	1.0	--	--	--	--	13.0
Utah	--	--	--	9.0	9.0	--	--	--	--	2.0
San Juan River TOTAL	594.0	17.0	577.1	136.0	79.4	56.6	--	--	--	98.7

TABLE F-5

REGIONAL COAL PRODUCTION AND USE SUMMARY
NO NEW LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	103.0	--	103.0	282.0	208.4	73.9	--	--	--	70.6
California	--	--	--	139.0	111.2	--	--	--	27.8	29.7
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.9
Oregon/Washington	--	--	--	274.0	274.0	--	--	--	--	60.0
Other West	103.0	--	103.0	706.0	604.6	73.9	--	--	27.8	163.2
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	350.0	350.0	--	--	--	--	77.5
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	539.0	471.1	--	--	--	67.9	113.9
Minnesota/Wisconsin	--	--	--	331.0	310.8	--	--	--	20.2	76.3
Mississippi	--	--	--	24.0	24.0	--	--	--	--	5.9
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	213.0	213.0	--	--	--	--	49.4
Other East	--	--	--	2,067.0	1,865.1	--	--	--	201.9	450.2
SUBTOTAL										
OTHER U.S. - TOTALS	103.0	--	103.0	2,773.0	2,469.7	73.9	--	--	229.7	613.4
EASTERN U.S. TOTALS	9,334.4	6,473.1	2,864.4	10,136.0	9,096.0	--	180.4	59.8	815.0	4,088.5
WESTERN U.S. TOTALS	5,698.0	554.7	5,143.5	1,574.0	1,158.6	262.6	102.4	--	50.6	959.0
U.S. TOTALS	15,135.4	7,027.8	8,110.9	14,483.0	12,724.3	336.5	282.8	59.8	1,095.3	5,660.9

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-6

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PRLA's ONLY ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,295.0	--	1,295.0	821.0	501.6	--	--	--	319.4	467.0
Ohio	421.2	240.1	181.1	729.0	577.4	--	--	--	151.6	243.4
Maryland	33.0	22.4	10.6	13.0	6.8	--	--	--	6.2	11.9
West Virginia	368.4	287.4	81.0	176.0	111.6	--	--	--	64.4	123.8
Northern Appalachian TOTAL	2,117.6	549.9	1,567.7	1,739.0	1,197.4	--	--	--	541.6	846.1
West Virginia	906.0	706.7	199.3	201.0	201.0	--	--	--	--	233.1
Virginia	213.9	154.0	59.9	136.0	136.0	--	--	--	--	74.0
Kentucky	924.2	619.2	305.0	83.5	83.5	--	--	--	--	194.3
Tennessee	11.7	4.9	6.8	140.6	139.2	--	--	--	1.4	33.1
Central Appalachian TOTAL	2,055.8	1,484.8	571.0	561.1	559.7	--	--	--	1.4	534.5
Tennessee	14.9	4.3	10.6	73.6	73.6	--	--	--	--	22.3
Georgia	--	--	--	466.8	466.8	--	--	--	--	103.7
Alabama	250.0	135.0	115.0	505.4	429.6	--	--	--	75.8	169.8
Southern Appalachian TOTAL	264.9	139.3	125.6	1,045.8	970.0	--	--	--	75.8	295.8
Iowa	--	--	--	74.3	74.3	--	--	--	--	16.2
Illinois	1,270.4	1,003.6	266.8	466.7	415.4	--	12.1	--	39.2	348.0
Indiana	344.9	169.0	175.9	656.4	496.2	--	--	--	160.2	200.7
Kentucky	444.4	240.0	204.4	342.6	316.2	--	--	11.6	14.7	149.9
Eastern Interior TOTAL	2,059.7	1,412.6	647.1	1,540.0	1,302.1	--	12.1	11.6	214.1	714.8
Missouri	72.7	27.6	45.0	292.3	292.3	--	--	--	--	80.7
Arkansas	13.0	8.3	4.7	356.0	356.0	--	--	--	--	80.3
Oklahoma	28.0	6.7	21.3	23.8	23.8	--	--	--	--	9.8
Kansas	7.9	--	7.9	18.3	18.3	--	--	--	--	8.0
Nebraska	--	--	--	199.4	199.4	--	--	--	--	60.1
Iowa	15.0	9.0	6.0	120.8	118.1	--	--	--	2.7	31.9
Western Interior TOTAL	136.6	51.6	84.9	1,010.6	1,007.9	--	--	--	2.7	270.8
Texas	637.0	--	637.0	1,218.2	1,185.3	--	17.1	--	15.8	339.3
Louisiana	--	--	--	10.5	10.5	--	--	--	--	2.4
Arkansas	--	--	--	137.4	137.4	--	--	--	--	31.9
Texas TOTAL	637.0	--	637.0	1,366.1	1,333.2	--	17.1	--	15.8	373.6

TABLE F-6

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PRLA's ONLY ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	650.0	--	650.0	128.2	128.2	--	--	--	--	92.2
Wyoming	1,400.0	--	1,400.0	37.7	37.7	--	--	--	--	133.6
Powder River TOTAL	2,050.0	--	2,050.0	165.9	165.9	--	--	--	--	225.8
Montana	5.0	--	5.0	6.9	6.9	--	--	--	--	4.4
North Dakota	295.0	--	295.0	145.0	57.0	88.0	--	--	--	54.7
South Dakota	19.0	--	19.0	69.2	69.2	--	--	--	--	17.2
Fort Union TOTAL	319.0	--	319.0	221.1	133.1	88.0	--	--	--	76.3
Wyoming	630.0	--	630.0	27.5	27.5	--	--	--	--	63.8
Colorado	149.0	38.7	110.3	1.0	1.0	--	--	--	--	19.8
Idaho	--	--	--	140.3	140.3	--	--	--	--	31.8
Utah	--	--	--	9.6	9.6	--	--	--	--	2.3
Green River-Basin Fork TOTAL	779.0	38.7	740.3	178.4	178.4	--	--	--	--	117.7
Colorado	33.0	11.2	21.8	196.6	180.1	--	--	--	16.5	55.5
New Mexico	17.0	17.0	--	13.9	13.9	--	--	--	--	8.0
Denver-Raton Mesa TOTAL	50.9	28.2	21.8	210.5	194.0	--	--	--	16.5	63.5
Colorado	49.0	28.4	20.6	2.0	2.0	--	--	--	--	8.0
Utah	251.0	223.4	27.6	176.6	164.9	--	--	--	11.7	87.7
Uinta-Southwestern Utah TOTAL	300.0	251.8	48.2	178.6	166.9	--	--	--	11.7	95.7
New Mexico	230.0	4.6	225.4	79.8	79.8	--	--	--	--	42.4
Colorado	18.0	8.1	9.9	1.0	1.0	--	--	--	--	2.8
Utah	--	--	--	7.7	7.7	--	--	--	--	1.7
San Juan River TOTAL	248.0	12.7	235.3	88.5	88.5	--	--	--	--	46.9

TABLE F-6

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PRLA's ONLY ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)
 (concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	37.8	--	37.8	201.4	125.7	75.7	--	--	--	45.5
California	--	--	--	69.7	50.9	18.8	--	--	--	14.8
Nevada	--	--	--	10.6	10.6	--	--	--	--	2.7
Oregon/Washington	--	--	--	48.2	48.2	--	--	--	--	10.7
Other West	37.8	--	37.8	329.9	235.4	94.5	--	--	--	73.7
CONNECTICUT/Rhode Island/Massachusetts	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	101.6	101.6	--	--	--	--	23.0
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	344.2	288.2	--	--	--	55.4	72.0
Minnesota/Wisconsin	--	--	--	433.5	380.2	--	--	--	53.3	94.9
Mississippi	--	--	--	18.8	18.8	--	--	--	--	4.6
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/South Carolina	--	--	--	346.2	346.2	--	--	--	--	77.6
Other East	--	--	--	1,550.3	1,346.9	--	--	--	203.4	333.7
OTHER U.S. - TOTALS	37.8	--	37.8	1,880.2	1,582.3	94.5	--	--	203.4	407.4
EASTERN U.S. TOTALS	7,271.6	3,638.2	3,633.3	7,262.6	6,370.3	--	29.2	11.6	851.4	3,035.6
WESTERN U.S. TOTALS	3,746.0	331.4	3,414.6	1,043.0	926.8	88.0	--	--	28.2	625.9
U.S. TOTALS	11,055.4	3,969.6	7,085.7	10,185.8	8,879.4	182.5	29.2	11.6	1,083.0	4,068.9

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-7

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 PRLA's ONLY ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,130.7	848.0	282.7	884.1	591.5	--	19.4	--	273.2	461.7
Ohio	341.0	245.5	95.5	868.0	654.5	--	52.9	--	160.6	265.1
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.1
West Virginia	635.3	571.8	63.5	240.0	166.3	--	--	--	73.7	210.7
Northern Appalachian TOTAL	2,194.0	1,731.4	462.6	2,101.1	1,478.8	--	72.3	--	550.0	980.6
West Virginia	819.7	672.2	147.5	133.0	133.0	--	--	--	--	206.0
Virginia	308.6	234.5	74.1	147.0	147.0	--	--	--	--	96.6
Kentucky	969.2	717.2	252.0	108.0	108.0	--	--	--	--	216.3
Tennessee	7.6	4.3	3.3	474.8	473.4	--	--	--	1.4	105.7
Central Appalachian TOTAL	2,104.9	1,628.2	476.9	862.8	861.4	--	--	--	1.4	624.6
Tennessee	3.4	1.7	1.7	91.2	89.9	--	--	--	1.3	25.3
Georgia	--	--	--	593.4	593.4	--	--	--	--	132.0
Alabama	260.0	169.0	91.0	507.5	404.5	--	11.1	--	91.9	176.7
Southern Appalachian TOTAL	263.4	170.7	92.7	1,192.1	1,087.8	--	11.1	--	93.2	334.0
Iowa	--	--	--	28.7	28.2	--	--	--	0.5	6.3
Illinois	2,205.0	1,984.5	220.5	511.3	443.3	--	25.6	--	42.4	548.3
Indiana	330.4	251.1	79.3	707.3	514.2	--	22.6	--	170.5	214.7
Kentucky	609.0	389.8	219.2	499.5	424.1	--	--	59.9	15.5	213.2
Eastern Interior TOTAL	3,144.4	2,625.4	519.0	1,746.8	1,409.8	--	48.2	59.9	228.9	982.5
Missouri	112.5	74.2	38.8	274.0	274.0	--	--	--	--	84.9
Arkansas	21.0	16.6	4.4	879.5	861.9	--	17.6	--	--	194.8
Oklahoma	45.0	20.2	24.8	50.6	50.6	--	--	--	--	18.4
Kansas	5.1	--	5.1	66.4	53.9	--	12.5	--	--	18.2
Nebraska	--	--	--	244.7	244.7	--	--	--	--	76.4
Iowa	9.2	6.4	2.8	196.2	193.1	--	--	--	3.1	49.0
Western Interior TOTAL	192.8	117.4	75.9	1,711.4	1,678.2	--	30.1	--	3.1	441.7
Texas	1,164.1	--	1,164.1	2,248.0	2,216.5	--	18.0	--	13.5	617.7
Louisiana	--	--	--	21.0	21.0	--	--	--	--	4.7
Arkansas	--	--	--	203.3	203.3	--	--	--	--	47.0
Texas TOTAL	1,164.1	--	1,164.1	2,472.3	2,440.8	--	18.0	--	13.5	669.4

TABLE F-7

REGIONAL COAL PRODUCTION AND USE SUMMARIES
PRLA's ONLY ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)
(Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	1,100.0	--	1,100.0	202.2	114.8	--	87.4	--	--	145.5
Wyoming	2,450.0	--	2,450.0	70.2	14.2	55.9	--	--	--	229.6
Powder River TOTAL	3,550.0	--	3,550.0	272.4	129.0	55.9	87.4	--	--	375.1
Montana	5.0	--	5.0	17.5	2.0	--	15.5	--	--	6.6
North Dakota	450.0	--	450.0	282.0	201.6	80.4	--	--	--	99.2
South Dakota	19.0	--	19.0	146.4	146.4	--	--	--	--	34.7
Fort Union TOTAL	474.0	--	474.0	445.9	350.0	80.4	15.5	--	--	140.5
Wyoming	805.0	--	805.0	84.7	27.4	57.3	--	--	--	89.0
Colorado	205.0	82.0	123.0	--	--	--	--	--	--	30.2
Idaho	--	--	--	91.2	91.2	--	--	--	--	21.6
Utah	--	--	--	8.1	8.1	--	--	--	--	2.1
Green River-Battle Fork TOTAL	1,010.0	82.0	928.0	184.0	99.3	57.3	--	--	--	142.9
Colorado	65.0	31.8	33.2	287.5	263.4	--	--	--	24.1	93.4
New Mexico	40.0	40.0	--	8.1	8.1	--	--	--	--	12.2
Denver-Raton Mesa TOTAL	105.0	71.8	33.2	295.6	271.5	--	--	--	24.1	105.6
Colorado	120.0	97.2	22.8	--	--	--	--	--	--	25.5
Utah	300.0	264.0	36.0	205.3	181.1	--	--	--	24.4	103.4
Uinta-Southwestern Utah TOTAL	420.0	361.2	58.8	205.3	181.1	--	--	--	24.4	128.9
New Mexico	530.0	5.3	524.7	127.4	70.2	70.2	--	--	--	79.5
Colorado	19.0	11.2	7.8	--	--	--	--	--	--	14.1
Utah	--	--	--	8.1	8.1	--	--	--	--	1.8
San Juan River TOTAL	549.0	16.5	532.5	135.5	78.3	70.2	--	--	--	95.4

TABLE F-7

REGIONAL COAL PRODUCTION AND USE SUMMARIES
PRLA's ONLY ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	86.2	--	86.2	285.0	210.6	74.7	--	--	--	69.6
California	--	--	--	138.9	111.1	--	--	--	27.8	29.7
Nevada	--	--	--	10.8	10.8	--	--	--	--	2.9
Oregon/Washington	--	--	--	228.4	228.4	--	--	--	--	50.0
Other West	86.2	--	86.2	663.1	560.9	74.7	--	--	27.8	152.2
CONNECTICUT/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.3
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	350.9	350.9	--	--	--	--	77.7
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	505.9	442.2	--	--	--	63.7	106.9
Minnesota/Wisconsin	--	--	--	328.5	308.5	--	--	--	20.0	75.7
Mississippi	--	--	--	24.3	24.3	--	--	--	--	6.0
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	213.0	213.0	--	--	--	--	49.4
Other East	--	--	--	2,032.6	1,835.1	--	--	--	197.5	442.8
OTHER U.S. - TOTALS	86.2	--	86.2	2,695.7	2,396.0	74.7	--	--	225.3	595.0
EASTERN U.S. TOTALS	9,063.6	6,273.1	2,791.2	10,068.5	8,956.8	--	179.7	59.9	890.1	4,032.8
WESTERN U.S. TOTALS	6,108.0	531.5	5,576.5	1,538.7	1,109.2	263.8	102.9	--	48.5	988.4
U.S. TOTALS	15,257.8	6,804.6	8,453.9	14,302.9	12,462.0	338.5	282.6	59.9	1,163.9	5,616.2

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-8

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL^(a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,294.7	919.2	375.5	821.0	501.6	--	--	--	319.4	467.0
Ohio	420.8	239.9	180.9	729.0	577.4	--	--	--	151.6	243.3
Maryland	33.0	22.4	10.6	13.0	6.8	--	--	--	6.2	11.9
West Virginia	368.2	287.2	81.0	176.0	111.6	--	--	--	64.4	123.8
Northern Appalachian TOTAL	2,116.7	1,468.7	648.0	1,739.0	1,197.4	--	--	--	541.6	846.0
West Virginia	905.9	706.6	199.3	201.0	201.0	--	--	--	--	233.1
Virginia	212.5	153.0	59.5	136.0	136.0	--	--	--	--	73.8
Kentucky	918.4	615.1	303.1	83.3	83.3	--	--	--	--	193.2
Tennessee	11.7	4.9	6.8	140.4	139.0	--	--	--	1.4	33.0
Central Appalachian TOTAL	2,048.5	1,479.6	568.7	560.7	559.3	--	--	--	1.4	533.1
Tennessee	15.3	4.4	10.9	73.2	73.2	--	--	--	--	22.3
Georgia	--	--	--	466.0	466.0	--	--	--	--	103.5
Alabama	260.0	140.4	119.6	503.6	428.1	--	--	--	75.5	171.7
Southern Appalachian TOTAL	275.3	144.8	130.5	1,042.8	967.3	--	--	--	75.5	297.5
Iowa	--	--	--	74.0	74.0	--	--	--	--	16.2
Illinois	1,272.0	1,005.3	267.2	467.4	416.0	--	12.2	--	39.3	348.6
Indiana	346.6	169.6	176.8	656.2	496.1	--	--	--	160.1	201.0
Kentucky	452.1	244.1	208.0	342.3	315.9	--	--	11.6	14.7	151.0
Eastern Interior TOTAL	2,070.7	1,419.0	652.0	1,539.9	1,302.0	--	12.2	11.6	214.1	716.8
Missouri	73.9	28.1	45.8	291.8	291.8	--	--	--	--	80.7
Arkansas	15.0	9.6	5.4	359.8	359.8	--	--	--	--	81.4
Oklahoma	30.0	7.2	22.8	24.1	24.1	--	--	--	--	10.2
Kansas	7.4	--	7.4	18.6	18.6	--	--	--	--	7.9
Nebraska	--	--	--	199.9	199.9	--	--	--	--	60.2
Iowa	15.2	9.1	6.1	121.1	118.4	--	--	--	2.7	32.0
Western Interior TOTAL	141.5	54.0	87.5	1,015.3	1,012.6	--	--	--	2.7	272.4
Texas	645.7	--	645.7	1,221.0	1,188.0	--	17.1	--	15.9	340.7
Louisiana	--	--	--	10.6	10.6	--	--	--	--	2.4
Arkansas	--	--	--	139.7	139.7	--	--	--	--	32.4
Texas TOTAL	645.7	--	645.7	1,371.3	1,338.3	--	17.1	--	15.9	375.5

TABLE F-8

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	720.0	--	720.0	127.9	127.9	--	--	--	--	98.4
Wyoming	1,330.0	--	1,330.0	38.1	38.1	--	--	--	--	127.6
Powder River TOTAL	2,050.0	--	2,050.0	166.0	166.0	--	--	--	--	226.0
Montana	5.0	--	5.0	6.9	6.9	--	--	--	--	4.4
North Dakota	295.0	--	295.0	145.0	57.0	88.0	--	--	--	54.7
South Dakota	19.0	--	19.0	69.2	69.2	--	--	--	--	17.2
Fort Union TOTAL	319.0	--	319.0	221.1	133.1	88.0	--	--	--	76.3
Wyoming	630.0	--	630.0	27.9	27.9	--	--	--	--	63.9
Colorado	140.0	36.4	103.6	1.0	1.0	--	--	--	--	18.6
Idaho	--	--	--	141.8	141.8	--	--	--	--	32.1
Utah	--	--	--	9.7	9.7	--	--	--	--	2.3
Green River-Hams Fork TOTAL	770.0	36.4	733.6	180.4	180.4	--	--	--	--	116.9
Colorado	33.0	11.2	21.8	196.6	180.1	--	--	--	16.5	55.5
New Mexico	17.0	17.0	--	13.9	13.9	--	--	--	--	8.0
Denver-Raton Mesa TOTAL	50.0	28.2	21.8	210.5	194.0	--	--	--	16.5	63.5
Colorado	46.0	26.7	19.3	2.0	2.0	--	--	--	--	7.5
Utah	251.0	223.4	27.6	178.1	166.3	--	--	--	11.8	88.1
Uinta-Southwestern Utah TOTAL	297.0	250.1	46.9	180.1	168.3	--	--	--	11.8	95.6
New Mexico	230.0	4.6	225.4	79.7	79.7	--	--	--	--	42.4
Colorado	18.0	8.1	9.9	1.0	1.0	--	--	--	--	2.8
Utah	--	--	--	7.8	7.8	--	--	--	--	1.7
San Juan River TOTAL	248.0	12.7	235.3	88.5	88.5	--	--	--	--	46.9

TABLE F-8

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	38.5	--	38.5	201.3	125.6	75.7	--	--	--	45.6
California	--	--	--	69.7	50.9	--	--	--	18.8	14.8
Nevada	--	--	--	10.7	10.7	--	--	--	--	2.7
Oregon/Washington	--	--	--	49.3	49.3	--	--	--	--	10.9
Other West	38.5	--	38.5	331.0	236.5	75.7	--	--	18.8	74.0
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	101.4	101.4	--	--	--	--	23.0
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	345.8	290.1	--	--	--	55.7	72.3
Minnesota/Wisconsin	--	--	--	435.8	382.2	--	--	--	53.6	95.4
Mississippi	--	--	--	18.7	18.7	--	--	--	--	4.6
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/South Carolina	--	--	--	346.3	346.3	--	--	--	--	77.7
Other East	--	--	--	1,554.0	1,350.0	--	--	--	204.0	334.6
SUBTOTAL										
OTHER U.S. - TOTALS	38.5	--	38.5	1,885.0	1,586.5	75.7	--	--	222.8	408.6
EASTERN U.S. TOTALS	7,298.4	4,566.1	2,732.4	7,269.0	6,376.9	--	29.3	11.6	851.2	3,041.3
WESTERN U.S. TOTALS	3,733.0	327.4	3,406.6	1,046.6	930.3	88.0	--	--	28.3	625.2
U.S. TOTALS	11,069.9	4,893.5	6,177.5	10,200.6	8,893.7	163.7	29.3	11.6	1,102.3	4,075.1

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-9

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,132.8	849.6	283.2	884.0	591.4	--	19.4	--	273.2	462.1
Ohio	341.0	245.5	95.5	868.0	654.5	--	52.9	--	160.6	265.1
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.1
West Virginia	635.5	572.0	63.5	240.0	166.3	--	--	--	73.7	210.8
Northern Appalachian TOTAL	2,196.3	1,733.2	463.1	2,101.0	1,478.7	--	72.3	--	550.0	981.1
West Virginia	819.6	672.1	147.5	133.0	133.0	--	--	--	--	206.0
Virginia	309.5	235.2	74.3	147.0	147.0	--	--	--	--	96.8
Kentucky	963.5	713.0	250.5	108.0	108.0	--	--	--	--	215.2
Tennessee	7.6	4.3	3.3	459.5	458.1	--	--	--	1.4	102.3
Central Appalachian TOTAL	2,100.2	1,624.5	475.6	847.5	846.1	--	--	--	1.4	620.3
Tennessee	3.7	1.8	1.9	91.0	89.7	--	--	--	1.3	25.3
Georgia	--	--	--	589.4	589.4	--	--	--	--	131.1
Alabama	260.0	169.0	91.0	500.7	399.1	--	11.0	--	90.6	175.2
Southern Appalachian TOTAL	263.7	170.7	92.9	1,181.1	1,078.2	--	11.0	--	91.9	331.6
Iowa	--	--	--	28.2	27.7	--	--	--	0.5	6.2
Illinois	2,350.9	2,115.8	235.1	505.3	438.1	--	25.3	--	41.9	575.1
Indiana	329.6	250.5	79.1	703.3	511.3	--	22.5	--	169.5	213.7
Kentucky	599.8	383.9	215.9	498.2	423.0	--	--	59.8	15.4	211.4
Eastern Interior TOTAL	3,280.3	2,750.2	530.1	1,735.0	1,400.1	--	47.8	59.8	227.3	1,006.4
Missouri	149.2	98.5	50.7	275.0	275.0	--	--	--	--	89.8
Arkansas	22.0	17.4	4.6	886.8	869.1	--	17.7	--	--	196.5
Oklahoma	52.0	23.4	28.6	51.0	51.0	--	--	--	--	19.5
Kansas	4.7	--	4.7	65.2	52.9	--	12.3	--	--	17.9
Nebraska	--	--	--	240.2	240.2	--	--	--	--	75.3
Iowa	14.3	10.0	4.3	192.5	189.4	--	--	--	3.1	48.9
Western Interior TOTAL	242.2	149.3	92.9	1,710.7	1,677.6	--	30.0	--	3.1	447.9
Texas	1,158.0	--	1,158.0	2,252.5	2,221.0	--	18.0	--	13.5	618.0
Louisiana	--	--	--	21.1	21.1	--	--	--	--	4.7
Arkansas	--	--	--	205.2	205.2	--	--	--	--	47.4
Texas TOTAL	1,158.0	--	1,158.0	2,478.8	2,447.3	--	18.0	--	13.5	670.1

TABLE F-9

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	1,199.9	--	1,199.9	198.4	112.7	--	85.7	--	--	153.8
Wyoming	1,960.0	--	1,960.0	71.0	14.3	56.6	--	--	--	187.3
Powder River TOTAL	3,159.9	--	3,159.9	269.4	127.0	56.6	85.7	--	--	341.1
Montana	7.0	--	7.0	17.4	2.0	--	15.4	--	--	6.8
North Dakota	480.0	--	480.0	279.1	199.6	79.5	--	--	--	100.8
South Dakota	19.0	--	19.0	152.4	152.4	--	--	--	--	36.0
Fort Union TOTAL	506.0	--	506.0	448.9	354.0	79.5	15.4	--	--	143.6
Wyoming	850.0	--	850.0	83.9	27.1	56.8	--	--	--	92.7
Colorado	192.0	76.8	115.2	--	--	--	--	--	--	28.4
Idaho	--	--	--	90.3	90.3	--	--	--	--	21.4
Utah	--	--	--	8.0	8.0	--	--	--	--	2.0
Green River-Hams Fork TOTAL	1,042.0	76.8	965.2	182.2	125.4	56.8	--	--	--	144.5
Colorado	65.0	31.9	33.2	289.4	265.1	--	--	--	24.3	92.0
New Mexico	41.0	41.0	--	8.0	8.0	--	--	--	--	12.4
Denver-Raton Mesa TOTAL	106.0	72.9	33.2	297.4	273.1	--	--	--	24.3	104.4
Colorado	103.0	83.4	19.6	--	--	--	--	--	--	22.9
Utah	345.0	303.6	41.4	206.6	182.2	--	--	--	24.6	111.9
Uinta-Southwestern Utah TOTAL	448.0	387.0	61.0	206.6	182.2	--	--	--	24.6	134.8
New Mexico	565.0	5.6	559.4	125.9	69.4	56.9	--	--	--	82.7
Colorado	19.0	11.2	7.8	--	--	--	--	--	--	13.3
Utah	--	--	--	8.0	8.0	--	--	--	--	1.8
San Juan River TOTAL	584.0	16.8	567.2	133.9	77.4	56.9	--	--	--	97.8

TABLE F-9

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 SHORT-TERM LEASING ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	102.3	--	102.3	281.7	208.2	73.8	--	--	--	70.5
California	--	--	--	137.7	110.2	--	--	--	27.5	29.4
Nevada	--	--	--	10.5	10.5	--	--	--	--	2.8
Oregon/Washington	--	--	--	233.2	233.2	--	--	--	--	51.1
Other West SUBTOTAL	102.3	--	102.3	663.1	562.1	73.8	--	--	27.5	153.8
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	349.9	349.9	--	--	--	--	77.5
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	509.2	445.0	--	--	--	64.2	107.6
Minnesota/Wisconsin	--	--	--	330.5	310.3	--	--	--	20.2	76.1
Mississippi	--	--	--	24.0	24.0	--	--	--	--	5.9
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	213.3	213.3	--	--	--	--	49.4
Other East SUBTOTAL	--	--	--	2,036.9	1,838.7	--	--	--	198.2	442.7
OTHER U.S. - TOTALS	102.3	--	102.3	2,700.0	2,400.8	73.8	--	--	225.7	596.5
EASTERN U.S. TOTALS	9,240.7	6,427.9	2,812.6	10,054.1	8,928.0	--	179.1	59.8	887.2	4,057.4
WESTERN U.S. TOTALS	5,845.9	553.5	5,292.5	1,538.4	1,139.1	249.8	101.1	--	48.9	966.2
U.S. TOTALS	15,188.9	6,981.4	8,207.4	14,292.5	12,467.9	323.6	280.2	59.8	1,161.8	5,620.1

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-10

REGIONAL COAL PRODUCTION AND USE SUMMARIES
MEET INDUSTRY NEEDS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,284.3	911.9	372.4	821.0	501.6	--	--	--	319.4	465.6
Ohio	419.5	239.1	180.4	729.0	577.4	--	--	--	151.6	243.5
Maryland	33.0	22.4	10.6	13.0	6.8	--	--	--	6.2	12.0
West Virginia	367.5	286.7	80.9	176.0	111.6	--	--	--	64.4	123.7
Northern Appalachian TOTAL	2,104.3	1,460.1	644.3	1,739.0	1,197.4	--	--	--	541.6	844.8
West Virginia	899.8	701.8	198.0	201.0	201.0	--	--	--	--	232.2
Virginia	204.0	146.9	57.1	136.0	136.0	--	--	--	--	72.3
Kentucky	810.0	542.7	267.3	83.2	83.2	--	--	--	--	174.1
Tennessee	11.0	4.6	6.4	140.3	138.9	--	--	--	1.4	32.9
Central Appalachian TOTAL	1,924.8	1,396.0	528.8	560.5	559.1	--	--	--	1.4	511.5
Tennessee	15.5	4.5	11.0	73.1	73.1	--	--	--	--	22.4
Georgia	--	--	--	464.3	464.3	--	--	--	--	103.2
Alabama	300.0	162.0	138.0	502.8	427.4	--	--	--	75.4	181.0
Southern Appalachian TOTAL	315.5	166.5	149.0	1,040.2	964.8	--	--	--	75.4	306.6
Iowa	--	--	--	76.0	76.0	--	--	--	--	16.6
Illinois	1,168.5	923.1	245.4	475.7	423.4	--	12.4	--	40.0	331.3
Indiana	338.8	166.0	172.8	655.7	495.7	--	--	--	160.0	199.8
Kentucky	453.8	245.1	208.7	342.2	315.9	--	--	11.6	14.7	151.6
Eastern Interior TOTAL	1,961.1	1,334.2	626.9	1,549.6	1,311.0	--	12.4	11.6	214.7	699.3
Missouri	19.7	7.5	12.2	292.8	292.8	--	--	--	--	74.2
Arkansas	17.0	10.9	6.1	385.2	385.2	--	--	--	--	87.3
Oklahoma	33.0	7.9	25.1	25.6	25.6	--	--	--	--	11.0
Kansas	2.2	--	2.2	19.2	19.2	--	--	--	--	7.3
Nebraska	--	--	--	205.2	205.2	--	--	--	--	62.0
Iowa	10.3	6.2	4.1	125.4	122.6	--	--	--	2.8	32.4
Western Interior TOTAL	82.2	32.5	49.7	1,053.4	1,050.6	--	--	--	2.8	274.2
Texas	502.1	--	502.1	1,196.7	1,164.4	--	16.8	--	15.6	323.7
Louisiana	--	--	--	11.3	11.3	--	--	--	--	2.5
Arkansas	--	--	--	150.6	150.6	--	--	--	--	34.9
Texas TOTAL	502.1	--	502.1	1,358.6	1,326.3	--	16.8	--	15.6	361.1

TABLE F-10

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 MEET INDUSTRY NEEDS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-PELLET ² POPULATION
Montana	950.0	--	950.0	130.1	130.1	--	--	--	--	120.0
Wyoming	1,300.0	--	1,300.0	40.4	40.4	--	--	--	--	125.7
Powder River TOTAL	2,250.0	--	2,250.0	170.5	170.5	--	--	--	--	245.7
Montana	5.0	--	5.0	7.2	7.2	--	--	--	--	4.5
North Dakota	345.0	--	345.0	145.0	57.0	88.0	--	--	--	58.7
South Dakota	19.0	--	19.0	80.8	80.8	--	--	--	--	19.8
Fort Union TOTAL	369.0	--	369.0	233.0	145.0	88.0	--	--	--	83.0
Wyoming	971.0	--	971.0	29.3	29.3	--	--	--	--	93.8
Colorado	149.0	38.7	110.3	1.0	1.0	--	--	--	--	19.8
Idaho	--	--	--	150.8	150.8	--	--	--	--	34.2
Utah	--	--	--	9.7	9.7	--	--	--	--	2.3
Green River-Hans Fork TOTAL	1,120.0	38.7	1,081.3	190.8	190.8	--	--	--	--	150.1
Colorado	53.0	18.0	35.0	206.7	189.3	--	--	--	17.4	60.9
New Mexico	7.0	7.0	--	13.9	13.9	--	--	--	--	5.8
Denver-Raton Mesa TOTAL	60.0	25.0	35.0	220.6	203.2	--	--	--	17.4	66.7
Colorado	57.0	33.1	23.9	2.0	2.0	--	--	--	--	9.2
Utah	293.0	260.8	32.2	182.9	170.8	--	--	--	12.1	97.0
Uinta-Southwestern Utah TOTAL	350.0	293.9	56.1	184.9	172.8	--	--	--	12.1	106.2
New Mexico	285.0	5.7	279.3	79.8	79.8	--	--	--	--	48.0
Colorado	15.0	6.8	8.3	1.0	1.0	--	--	--	--	2.4
Utah	--	--	--	7.7	7.7	--	--	--	--	1.7
San Juan River TOTAL	300.0	12.5	287.6	88.5	88.5	--	--	--	--	52.1

TABLE F-10

REGIONAL COAL PRODUCTION AND USE SUMMARIES
MEET INDUSTRY NEEDS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL^(a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	68.0	--	68.0	202.7	126.5	76.2	--	--	--	48.7
California	--	--	--	69.3	50.6	--	--	--	18.7	14.9
Nevada	--	--	--	10.7	10.7	--	--	--	--	2.7
Oregon/Washington	--	--	--	53.1	53.1	--	--	--	--	11.7
Other West	68.0	--	68.0	335.8	240.9	76.2	--	--	18.7	78.0
CONNECTICUT/RHODE ISLAND/MASSACHUSETTS	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	101.0	101.0	--	--	--	--	22.9
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	351.0	294.5	--	--	--	56.5	73.4
Minnesota/Wisconsin	--	--	--	453.6	397.8	--	--	--	55.8	99.3
Mississippi	--	--	--	18.7	18.7	--	--	--	--	4.6
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/South Carolina	--	--	--	346.5	346.5	--	--	--	--	--
Other East	--	--	--	1,576.8	1,369.8	--	--	--	207.0	338.7
OTHER U.S. - TOTALS	68.0	--	68.0	1,912.6	1,610.7	76.2	--	--	225.7	417.6
EASTERN U.S. TOTALS	6,890.0	4,389.3	2,500.8	7,301.3	6,409.2	--	29.2	11.6	851.5	2,997.5
WESTERN U.S. TOTALS	4,449.0	370.1	4,079.0	1,088.3	970.8	88.0	--	--	29.5	704.1
U.S. TOTALS	11,507.0	4,759.4	6,647.8	10,302.2	8,990.7	164.2	29.2	11.6	1,106.7	4,119.2

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-11

COAL PRODUCTION AND USE SUMMARIES
MEET INDUSTRY NEEDS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,115.7	836.8	278.9	884.1	591.5	--	19.4	--	273.2	459.2
Ohio	341.0	245.5	95.5	868.0	654.5	--	52.9	--	160.6	265.6
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.2
West Virginia	634.3	570.9	63.4	240.0	166.3	--	--	--	73.7	210.6
Northern Appalachian TOTAL	2,178.0	1,719.3	458.7	2,101.1	1,478.8	--	72.3	--	550.0	978.6
West Virginia	818.0	670.8	147.2	133.0	133.0	--	--	--	--	205.9
Virginia	308.5	234.5	74.0	147.0	147.0	--	--	--	--	96.8
Kentucky	832.8	616.3	216.5	108.0	108.0	--	--	--	--	191.6
Tennessee	71.0	39.8	31.2	466.2	464.8	--	--	--	1.4	114.5
Central Appalachian TOTAL	2,030.3	1,561.4	468.9	854.2	852.8	--	--	--	1.4	608.8
Tennessee	3.5	1.8	1.7	91.1	89.8	--	--	--	1.3	25.4
Georgia	--	--	--	591.2	591.2	--	--	--	--	131.6
Alabama	300.0	195.0	105.0	503.7	401.5	--	11.1	--	91.2	185.8
Southern Appalachian TOTAL	303.5	196.8	106.7	1,186.0	1,082.5	--	11.1	--	92.5	342.8
Iowa	--	--	--	29.7	29.2	--	--	--	0.5	6.5
Illinois	2,104.8	1,894.3	210.5	515.3	446.8	--	25.8	--	42.8	530.2
Indiana	317.2	241.1	76.1	703.2	511.2	--	22.5	--	169.5	211.7
Kentucky	423.7	271.2	152.5	498.8	423.5	--	--	59.9	15.5	184.0
Eastern Interior TOTAL	2,845.7	2,406.6	439.1	1,747.0	1,410.7	--	48.3	59.9	228.3	932.4
Missouri	22.0	14.5	7.5	283.3	283.3	--	--	--	--	75.4
Arkansas	23.0	18.2	4.8	940.4	921.6	--	18.8	--	--	208.3
Oklahoma	47.0	21.2	25.8	54.8	54.8	--	--	--	--	19.6
Kansas	2.0	--	2.0	68.5	55.6	--	12.9	--	--	18.2
Nebraska	--	--	--	252.4	252.4	--	--	--	--	78.7
Iowa	8.2	5.7	2.5	202.3	199.1	--	--	--	3.2	50.3
Western Interior TOTAL	102.2	59.6	42.6	1,801.7	1,766.8	--	31.7	--	3.2	450.5
Texas	589.3	--	589.3	2,235.8	2,204.5	--	17.9	--	13.4	565.8
Louisiana	--	--	--	22.0	22.0	--	--	--	--	4.9
Arkansas	--	--	--	219.4	219.4	--	--	--	--	50.6
Texas TOTAL	589.3	--	589.3	2,477.2	2,445.9	--	17.9	--	13.4	621.3

TABLE F-11

COAL PRODUCTION AND USE SUMMARIES
 MEET INDUSTRY NEEDS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	2,326.9	--	2,326.9	200.0	113.6	--	86.4	--	--	256.5
Wyoming	2,173.0	--	2,173.0	80.3	16.2	64.0	--	--	--	207.5
Powder River TOTAL	4,499.9	--	4,499.9	280.3	129.8	64.0	86.4	--	--	464.0
Montana	5.0	--	5.0	19.8	2.2	--	17.6	--	--	7.1
North Dakota	495.0	--	495.0	289.6	207.1	82.5	--	--	--	104.3
South Dakota	19.0	--	19.0	159.1	159.1	--	--	--	--	37.5
Fort Union TOTAL	519.0	--	519.0	468.5	368.4	82.5	17.6	--	--	148.9
Wyoming	1,296.0	--	1,296.0	95.7	30.9	64.8	--	--	--	133.6
Colorado	204.0	81.6	122.4	--	--	--	--	--	--	30.1
Idaho	--	--	--	102.9	102.9	--	--	--	--	24.2
Utah	--	--	--	8.5	8.5	--	--	--	--	2.2
Green River- Hams Fork TOTAL	1,500.0	81.6	1,418.4	207.1	142.3	64.8	--	--	--	190.1
Colorado	91.0	44.6	46.4	303.3	277.8	--	--	--	25.5	98.7
New Mexico	9.0	9.0	--	8.0	8.0	--	--	--	--	5.4
Denver-Raton Mesa TOTAL	100.0	53.6	46.4	311.3	285.8	--	--	--	25.5	104.1
Colorado	136.0	110.2	25.8	--	--	--	--	--	--	27.2
Utah	364.0	320.3	43.7	220.3	194.3	--	--	--	26.2	118.4
Uinta-Southwestern Utah TOTAL	500.0	430.2	69.5	220.3	194.3	--	--	--	26.2	145.6
New Mexico	582.0	5.8	576.2	126.9	69.9	57.0	--	--	--	84.6
Colorado	18.0	10.6	7.4	--	--	--	--	--	--	13.9
Utah	--	--	--	8.5	8.5	--	--	--	--	1.9
San Juan River TOTAL	600.0	16.4	583.6	135.4	78.4	57.0	--	--	--	100.4

TABLE F-11

COAL PRODUCTION AND USE SUMMARIES
 MEET INDUSTRY NEEDS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	36.8	--	36.8	284.0	209.6	74.4	--	--	--	64.8
California	--	--	--	137.9	110.3	--	--	--	27.6	29.5
Nevada	--	--	--	11.1	11.1	--	--	--	--	2.9
Oregon/Washington	--	--	--	287.1	287.1	--	--	--	--	62.8
Other West	36.8	--	36.8	711.1	609.1	74.4	--	--	27.6	160.0
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	350.2	350.2	--	--	--	--	77.6
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	547.0	478.6	--	--	--	69.0	115.7
Minnesota/Wisconsin	--	--	--	347.0	325.8	--	--	--	21.2	78.9
Mississippi	--	--	--	23.7	23.7	--	--	--	--	5.9
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	213.0	213.0	--	--	--	--	94.5
Other East	--	--	--	2,090.9	1,887.5	--	--	--	204.0	499.8
SUBTOTAL										
OTHER U.S. - TOTALS	36.8	--	36.8	2,802.0	2,496.6	74.4	--	--	231.6	659.8
EASTERN U.S. TOTALS	8,049.0	5,943.7	2,105.3	10,167.2	9,037.5	--	181.3	59.9	888.8	3,934.4
WESTERN U.S. TOTALS	7,718.9	581.8	7,136.8	1,622.9	1,199.0	268.3	104.0	--	51.7	1,153.1
U.S. TOTALS	15,804.7	6,525.5	9,278.9	14,592.1	12,733.1	342.7	285.3	59.9	1,172.1	5,747.3

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-12

REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,293.0	918.0	375.0	821.0	501.6	--	--	--	319.4	466.6
Ohio	420.0	239.4	180.6	729.0	577.4	--	--	--	151.6	243.2
Maryland	33.0	22.4	10.6	103.0	53.7	--	--	--	49.3	28.6
West Virginia	369.0	287.8	81.2	176.0	111.6	--	--	--	64.4	123.9
Northern Appalachian TOTAL	2,115.0	1,467.6	647.4	1,829.0	1,244.3	--	--	--	584.7	862.3
West Virginia	910.0	709.8	200.2	201.0	201.0	--	--	--	--	233.9
Virginia	220.0	158.4	61.6	136.0	136.0	--	--	--	--	75.2
Kentucky	892.0	597.6	294.4	84.0	84.0	--	--	--	--	188.6
Tennessee	12.0	5.0	7.0	141.0	139.6	--	--	--	1.4	33.2
Central Appalachian TOTAL	2,034.0	1,470.8	563.2	562.0	560.6	--	--	--	1.4	530.9
Tennessee	7.0	2.0	5.0	48.0	48.0	--	--	--	--	15.2
Georgia	--	--	--	469.0	469.0	--	--	--	--	104.2
Alabama	214.0	115.6	98.4	509.0	432.7	--	--	--	76.4	162.3
Southern Appalachian TOTAL	221.0	117.6	103.4	1,026.0	949.7	--	--	--	76.4	281.7
Iowa	--	--	--	22.0	22.0	--	--	--	--	4.8
Illinois	1,257.0	993.0	264.0	483.0	429.9	--	12.6	--	40.6	349.0
Indiana	347.0	170.0	177.0	658.0	497.4	--	--	--	160.6	201.4
Kentucky	430.0	232.2	197.8	343.0	316.6	--	--	11.7	14.7	147.8
Eastern Interior TOTAL	2,034.0	1,395.2	638.8	1,506.0	1,265.9	--	12.6	11.7	215.9	703.0
Missouri	47.0	17.9	29.1	295.0	295.0	--	--	--	--	78.0
Arkansas	14.0	9.0	5.0	378.0	378.0	--	--	--	--	85.2
Oklahoma	28.0	6.7	21.3	27.0	27.0	--	--	--	--	10.5
Kansas	5.0	--	5.0	55.0	55.0	--	--	--	--	15.5
Nebraska	--	--	--	203.0	203.0	--	--	--	--	60.9
Iowa	14.0	8.4	5.6	144.0	140.8	--	--	--	3.2	36.8
Western Interior TOTAL	108.0	42.0	66.0	1,102.0	1,098.8	--	--	--	3.2	286.9
Texas	577.0	--	577.0	1,219.0	1,188.1	--	17.1	--	15.8	334.3
Louisiana	--	--	--	11.0	11.0	--	--	--	--	2.5
Arkansas	--	--	--	142.0	142.0	--	--	--	--	32.9
Texas TOTAL	577.0	--	577.0	1,372.0	1,341.1	--	17.1	--	15.8	369.7

TABLE F-12

REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)
(Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	864.0	--	864.0	124.0	124.0	--	--	--	--	110.6
Wyoming	1,182.0	--	1,182.0	39.0	39.0	--	--	--	--	115.0
Powder River TOTAL	2,046.0	--	2,046.0	163.0	163.0	--	--	--	--	225.6
Montana	5.0	--	5.0	12.0	12.0	--	--	--	--	5.5
North Dakota	195.0	--	195.0	145.0	57.0	88.0	--	--	--	47.4
South Dakota	19.0	--	19.0	46.0	46.0	--	--	--	--	12.2
Fort Union TOTAL	219.0	--	219.0	203.0	115.0	88.0	--	--	--	65.1
Wyoming	971.0	--	971.0	29.0	29.0	--	--	--	--	93.7
Colorado	149.0	38.7	110.3	1.0	1.0	--	--	--	--	19.8
Idaho	--	--	--	148.0	148.0	--	--	--	--	33.5
Utah	--	--	--	10.0	10.0	--	--	--	--	2.4
Green River-Hams Fork TOTAL	1,120.0	38.7	1,081.3	188.0	188.0	--	--	--	--	149.4
Colorado	53.0	18.0	35.0	214.0	196.0	--	--	--	18.0	62.1
New Mexico	7.0	7.0	--	26.0	26.0	--	--	--	--	8.4
Denver-Raton Mesa TOTAL	60.0	25.0	35.0	240.0	222.0	--	--	--	18.0	70.5
Colorado	43.0	24.9	18.1	2.0	2.0	--	--	--	--	7.1
Utah	221.0	196.7	24.3	181.0	169.1	--	--	--	11.9	83.1
Uinta-Southwestern Utah TOTAL	264.0	221.6	42.4	183.0	171.1	--	--	--	11.9	90.2
New Mexico	210.0	4.2	205.8	68.0	68.0	--	--	--	--	37.9
Colorado	11.0	5.0	6.1	1.0	1.0	--	--	--	--	1.8
Utah	--	--	--	8.0	8.0	--	--	--	--	1.8
San Juan River TOTAL	221.0	9.2	211.9	77.0	77.0	--	--	--	--	41.5

TABLE F-12

REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	66.0	--	66.0	202.0	126.0	76.0	--	--	--	48.3
California	--	--	--	70.0	51.1	--	--	--	18.9	14.9
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.8
Oregon/Washington	--	--	--	51.0	51.0	--	--	--	--	11.3
Other West SUBTOTAL	66.0	--	66.0	334.0	239.1	76.0	--	--	18.9	77.3
Connecticut/Rhode Island/Massachusetts	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	102.0	102.0	--	--	--	--	23.1
Maine/New Hampshire/ Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	349.0	292.8	--	--	--	56.2	73.0
Minnesota/Wisconsin	--	--	--	435.0	381.5	--	--	--	53.5	95.2
Mississippi	--	--	--	19.0	19.0	--	--	--	--	4.6
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/ South Carolina	--	--	--	346.0	346.0	--	--	--	--	77.6
Other East SUBTOTAL	--	--	--	1,555.0	1,352.6	--	--	--	204.4	335.1
OTHER U.S. - TOTALS	66.0	--	66.0	1,891.0	1,591.7	76.0	--	--	223.3	412.4
EASTERN U.S. TOTALS	7,089.0	4,493.2	2,595.8	7,397.0	6,460.4	--	29.7	11.7	897.4	3,034.5
WESTERN U.S. TOTALS	3,930.0	294.5	3,635.6	1,054.0	936.1	88.0	--	--	29.9	642.3
U.S. TOTALS	11,085.0	4,787.7	6,297.4	10,342.0	8,988.2	164.0	29.7	11.7	1,150.6	4,089.2

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-13
REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,184.0	888.0	296.0	884.0	591.4	--	19.4	--	273.2	474.6
Ohio	340.0	244.8	95.2	868.0	654.5	--	52.9	--	160.6	265.4
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.2
West Virginia	612.0	550.8	61.2	240.0	166.3	--	--	--	73.7	205.0
Northern Appalachian TOTAL	2,223.0	1,749.7	473.3	2,101.0	1,478.7	--	72.3	--	550.0	988.2
West Virginia	824.0	675.7	148.3	133.0	133.0	--	--	--	--	207.2
Virginia	310.0	235.6	74.4	147.0	147.0	--	--	--	--	97.1
Kentucky	914.0	676.4	237.6	108.0	108.0	--	--	--	--	206.6
Tennessee	7.0	3.9	3.1	458.0	456.6	--	--	--	1.4	101.9
Central Appalachian TOTAL	2,055.0	1,591.6	463.4	846.0	844.6	--	--	--	1.4	612.8
Tennessee	7.0	3.5	3.5	91.0	89.7	--	--	--	1.3	26.1
Georgia	--	--	--	589.0	589.0	--	--	--	--	131.1
Alabama	138.0	89.7	48.3	500.0	398.5	--	11.0	--	90.5	145.9
Southern Appalachian TOTAL	145.0	93.2	51.8	1,180.0	1,077.2	--	11.0	--	91.8	303.1
Iowa	2.0	0.5	1.5	29.0	28.5	--	--	--	0.5	6.5
Illinois	2,419.0	2,177.1	241.9	512.0	443.9	--	25.6	--	42.5	590.1
Indiana	364.0	276.6	87.4	711.0	516.9	--	22.8	--	171.4	222.0
Kentucky	340.0	217.6	122.4	498.0	422.8	--	--	59.8	15.4	170.5
Eastern Interior TOTAL	3,125.0	2,671.8	453.2	1,750.0	1,412.1	--	48.4	59.8	229.8	989.1
Missouri	55.0	36.3	18.7	283.0	283.0	--	--	--	--	79.6
Arkansas	19.0	15.0	4.0	941.0	922.2	--	18.8	--	--	207.9
Oklahoma	15.0	6.8	8.3	55.0	55.0	--	--	--	--	15.1
Kansas	2.0	--	2.0	67.0	54.4	--	12.6	--	--	17.9
Nebraska	--	--	--	247.0	247.0	--	--	--	--	77.5
Iowa	10.0	7.0	3.0	198.0	194.8	--	--	--	3.2	49.6
Western Interior TOTAL	101.0	65.1	36.0	1,791.0	1,756.4	--	31.4	--	3.2	447.3
Texas	796.0	--	796.0	2,258.0	2,226.4	--	18.1	--	13.5	588.6
Louisiana	--	--	--	22.0	22.0	--	--	--	--	4.9
Arkansas	--	--	--	220.0	220.0	--	--	--	--	50.7
Texas TOTAL	796.0	--	796.0	2,500.0	2,468.4	--	18.1	--	13.5	644.2

TABLE F-13

REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)
(Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	2,048.0	--	2,048.0	198.0	112.5	--	85.5	--	--	230.8
Wyoming	1,913.0	--	1,913.0	78.0	15.8	62.2	--	--	--	184.6
Powder River TOTAL	3,961.0	--	3,961.0	276.0	128.3	62.2	85.5	--	--	415.4
Montana	5.0	--	5.0	19.0	2.1	--	16.9	--	--	7.0
North Dakota	201.0	--	201.0	285.0	203.8	81.2	--	--	--	81.8
South Dakota	19.0	--	19.0	90.0	90.0	--	--	--	--	22.4
Fort Union TOTAL	225.0	--	225.0	394.0	295.9	81.2	16.9	--	--	111.2
Wyoming	1,291.0	--	1,291.0	92.0	29.7	62.3	--	--	--	132.5
Colorado	204.0	81.6	122.4	1.0	1.0	--	--	--	--	30.3
Idaho	--	--	--	99.0	99.0	--	--	--	--	23.3
Utah	--	--	--	9.0	9.0	--	--	--	--	2.3
Green River-Blues Fork TOTAL	1,495.0	81.6	1,413.4	201.0	138.7	62.3	--	--	--	188.4
Colorado	68.0	33.3	34.7	305.0	279.4	--	--	--	25.6	88.6
New Mexico	7.0	7.0	--	8.0	8.0	--	--	--	--	4.9
Denver-Raton Mesa TOTAL	75.0	40.3	34.7	313.0	287.4	--	--	--	25.6	93.5
Colorado	77.0	62.4	14.6	1.0	1.0	--	--	--	--	13.4
Utah	206.0	181.3	24.7	217.0	191.4	--	--	--	25.8	88.7
Uinta-Southwestern Utah TOTAL	283.0	243.7	39.3	218.0	192.4	--	--	--	25.8	102.1
New Mexico	560.0	5.6	554.4	126.0	69.4	56.6	--	--	--	82.3
Colorado	17.0	10.0	7.0	1.0	1.0	--	--	--	--	2.9
Utah	--	--	--	9.0	9.0	--	--	--	--	2.0
San Juan River TOTAL	577.0	15.6	561.4	136.0	79.4	56.6	--	--	--	87.2

TABLE F-13

REGIONAL COAL PRODUCTION AND USE SUMMARIES
DOE GOALS ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL (a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	83.0	--	83.0	282.0	208.4	73.9	--	--	--	66.8
California	--	--	--	140.0	112.0	--	--	--	28.0	29.9
Nevada	--	--	--	12.0	12.0	--	--	--	--	3.1
Oregon/Washington	--	--	--	274.0	274.0	--	--	--	--	60.0
Other West	83.0	--	83.0	708.0	606.4	73.9	--	--	28.0	159.8
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	350.0	350.0	--	--	--	--	77.6
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	538.0	470.2	--	--	--	67.8	113.7
Minnesota/Wisconsin	--	--	--	308.0	289.2	--	--	--	18.8	71.5
Mississippi	--	--	--	25.0	25.0	--	--	--	--	6.1
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	214.0	214.0	--	--	--	--	49.7
Other East	--	--	--	2,045.0	1,844.6	--	--	--	200.4	445.8
SUBTOTAL										
OTHER U.S. - TOTALS	83.0	--	83.0	2,753.0	2,451.0	73.9	--	--	228.4	615.6
EASTERN U.S. TOTALS	8,445.0	6,171.4	2,273.7	10,168.0	9,037.4	--	181.2	59.8	889.7	3,984.7
WESTERN U.S. TOTALS	6,616.0	381.2	6,234.8	1,538.0	1,122.1	262.3	102.4	--	51.4	997.8
U.S. TOTALS	15,144.0	6,552.6	8,591.5	14,459.0	12,610.5	336.2	283.6	59.8	1,169.5	5,598.1

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-14

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 STATE DETERMINATION ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,288.6	914.9	373.7	821.0	501.6	--	--	--	319.4	465.9
Ohio	420.0	239.4	180.8	729.0	577.4	--	--	--	151.6	243.3
Maryland	33.0	22.4	10.6	13.0	6.8	--	--	--	6.2	11.9
West Virginia	369.2	288.0	81.2	176.0	111.6	--	--	--	64.4	124.0
Northern Appalachian TOTAL	2,110.8	1,464.7	646.3	1,739.0	1,197.4	--	--	--	541.6	845.1
West Virginia	909.0	709.0	200.0	201.0	201.0	--	--	--	--	233.8
Virginia	222.8	160.4	62.3	136.0	136.0	--	--	--	--	75.7
Kentucky	965.5	646.9	318.6	83.1	83.1	--	--	--	--	201.7
Tennessee	12.4	5.2	7.2	140.2	138.8	--	--	--	1.4	33.1
Central Appalachian TOTAL	2,109.7	1,521.5	588.1	560.3	558.9	--	--	--	1.4	544.3
Tennessee	15.7	4.6	11.1	73.0	73.0	--	--	--	--	22.4
Georgia	--	--	--	467.5	467.5	--	--	--	--	103.9
Alabama	214.0	115.6	98.4	501.9	426.6	--	--	--	75.3	160.8
Southern Appalachian TOTAL	229.7	120.2	109.5	1,042.4	967.1	--	--	--	75.3	287.1
Iowa	--	--	--	71.6	71.6	--	--	--	--	15.6
Illinois	1,315.0	1,038.9	276.2	465.3	414.1	--	12.1	--	39.1	356.2
Indiana	349.5	171.3	178.2	654.9	495.1	--	--	--	159.8	201.3
Kentucky	461.4	249.2	212.2	342.1	315.8	--	--	11.6	14.7	152.5
Eastern Interior TOTAL	2,125.9	1,459.4	666.6	1,533.9	1,296.6	--	12.1	11.6	213.6	725.6
Missouri	87.6	33.3	54.3	291.9	291.9	--	--	--	--	82.6
Arkansas	14.0	9.0	5.0	360.0	360.0	--	--	--	--	81.3
Oklahoma	28.0	6.7	21.3	24.4	24.4	--	--	--	--	10.0
Kansas	8.7	--	8.7	19.0	19.0	--	--	--	--	8.3
Nebraska	--	--	--	198.0	198.0	--	--	--	--	60.0
Iowa	19.9	11.9	8.0	118.7	116.1	--	--	--	2.6	32.2
Western Interior TOTAL	158.2	60.9	97.3	1,012.0	1,009.4	--	--	--	2.6	274.3
Texas	785.7	--	785.7	1,253.9	1,220.0	--	17.6	--	16.3	360.1
Louisiana	--	--	--	10.6	10.6	--	--	--	--	2.4
Arkansas	--	--	--	142.0	142.0	--	--	--	--	32.9
Texas TOTAL	785.7	--	785.7	1,406.5	1,372.6	--	17.6	--	16.3	395.4

TABLE F-14

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 STATE DETERMINATION ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Continued)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	864.0	--	864.0	125.0	125.0	--	--	--	--	110.0
Wyoming	973.0	--	973.0	38.0	38.0	--	--	--	--	96.7
Powder River TOTAL	1,837.0	--	1,837.0	163.0	163.0	--	--	--	--	207.6
Montana	5.0	--	5.0	6.6	6.6	--	--	--	--	4.3
North Dakota	350.0	--	350.0	145.0	57.0	88.0	--	--	--	58.9
South Dakota	19.0	--	19.0	82.0	82.0	--	--	--	--	20.0
Fort Union TOTAL	374.0	--	374.0	233.6	145.6	88.0	--	--	--	83.2
Wyoming	426.0	--	426.0	28.7	28.7	--	--	--	--	46.4
Colorado	149.0	38.7	110.3	1.0	1.0	--	--	--	--	19.8
Idaho	--	--	--	142.3	142.3	--	--	--	--	32.3
Utah	--	--	--	9.8	9.8	--	--	--	--	2.4
Green River-Horseshoe Fork TOTAL	575.0	38.7	536.3	181.8	181.8	--	--	--	--	100.9
Colorado	53.0	18.0	35.0	185.5	169.9	--	--	--	15.6	56.1
New Mexico	17.0	17.0	--	13.8	13.8	--	--	--	--	7.9
Denver-Raton Mesa TOTAL	70.0	35.0	35.0	199.3	183.7	--	--	--	15.6	64.0
Colorado	43.0	24.9	18.1	2.0	2.0	--	--	--	--	7.1
Utah	251.0	223.4	27.6	181.0	169.1	--	--	--	11.9	88.9
Uinta-Southwestern Utah TOTAL	294.0	248.3	45.7	183.0	171.1	--	--	--	11.9	96.0
New Mexico	309.0	6.2	302.8	79.6	79.6	--	--	--	--	50.3
Colorado	11.0	5.0	6.1	1.0	1.0	--	--	--	--	1.8
Utah	--	--	--	7.9	7.9	--	--	--	--	1.7
San Juan River TOTAL	320.0	11.2	308.9	88.5	88.5	--	--	--	--	53.8

TABLE F-14

REGIONAL COAL PRODUCTION AND USE SUMMARIES
STATE DETERMINATION ALTERNATIVE, 1985 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)
(Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	18.0	--	18.0	199.9	124.7	75.2	--	--	--	43.4
California	--	--	--	69.6	50.8	--	--	--	18.8	14.8
Nevada	--	--	--	10.8	10.8	--	--	--	--	2.7
Oregon/Washington	--	--	--	51.6	51.6	--	--	--	--	11.4
Other West SUBTOTAL	18.0	--	18.0	331.9	237.9	75.2	--	--	18.8	72.3
Connecticut/Rhode Island/Massachusetts	--	--	--	58.0	58.0	--	--	--	--	12.9
Delaware/New Jersey	--	--	--	24.0	24.0	--	--	--	--	5.8
Florida	--	--	--	101.7	101.7	--	--	--	--	23.0
Maine/New Hampshire/Vermont	--	--	--	20.0	20.0	--	--	--	--	4.4
Michigan	--	--	--	349.0	292.8	--	--	--	56.2	73.0
Minnesota/Wisconsin	--	--	--	448.9	393.7	--	--	--	55.2	98.2
Mississippi	--	--	--	18.5	18.5	--	--	--	--	4.5
New York	--	--	--	204.0	109.3	--	--	--	94.7	38.5
North Carolina/South Carolina	--	--	--	346.0	346.0	--	--	--	--	77.6
Other East SUBTOTAL	--	--	--	1,570.1	1,364.0	--	--	--	206.1	337.9
OTHER U.S. - TOTALS	18.0	--	18.0	1,902.0	1,601.9	75.2	--	--	224.9	410.2
EASTERN U.S. TOTALS	7,520.0	4,626.7	2,893.5	7,294.1	6,402.0	--	29.7	11.6	850.8	3,076.8
WESTERN U.S. TOTALS	3,470.0	333.2	3,136.9	1,049.2	933.7	88.0	--	--	27.5	605.5
U.S. TOTALS	11,008.0	4,959.9	6,048.4	10,245.3	8,942.1	163.2	29.7	11.6	1,103.2	4,092.5

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).

TABLE F-15

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 STATE DETERMINATION ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL^(a)
 (100,000 tons)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFACTION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Pennsylvania	1,186.0	889.5	296.5	883.9	591.3	--	19.4	--	273.1	473.7
Ohio	341.0	245.5	95.5	868.0	654.5	--	52.9	--	160.6	264.9
Maryland	87.0	66.1	20.9	109.0	66.5	--	--	--	42.5	43.0
West Virginia	639.3	575.4	63.9	240.0	166.3	--	--	--	73.7	211.7
Northern Appalachian TOTAL	2,253.3	1,776.5	476.8	2,100.9	1,478.6	--	72.3	--	549.9	975.3
West Virginia	822.0	674.0	148.0	133.0	133.0	--	--	--	--	206.4
Virginia	311.4	236.7	74.7	147.0	147.0	--	--	--	--	97.1
Kentucky	1,111.7	822.7	289.0	108.0	108.0	--	--	--	--	242.8
Tennessee	9.0	5.0	4.0	436.4	435.1	--	--	--	1.3	97.5
Central Appalachian TOTAL	2,254.1	1,738.4	515.7	824.4	823.1	--	--	--	1.3	643.8
Tennessee	4.5	2.3	2.2	90.8	89.5	--	--	--	1.3	25.3
Georgia	--	--	--	583.3	583.3	--	--	--	--	129.8
Alabama	138.0	89.7	48.3	490.4	390.8	--	10.8	--	88.8	143.6
Southern Appalachian TOTAL	142.5	92.0	50.5	1,164.5	1,063.6	--	10.8	--	90.1	298.7
Iowa	--	--	--	27.4	27.0	--	--	--	0.4	6.0
Illinois	2,659.8	2,393.8	266.0	497.1	431.0	--	24.9	--	41.3	632.9
Indiana	352.7	268.1	84.6	704.6	512.2	--	22.5	--	169.8	218.2
Kentucky	798.9	511.3	287.6	496.1	421.2	--	--	59.5	15.4	252.4
Eastern Interior TOTAL	3,811.4	3,173.2	638.2	1,725.2	1,391.4	--	47.4	59.5	226.9	1,109.5
Missouri	287.1	189.5	97.6	271.5	271.5	--	--	--	--	106.9
Arkansas	19.0	15.0	4.0	846.2	829.3	--	16.9	--	--	187.3
Oklahoma	15.0	6.8	8.2	48.4	48.4	--	--	--	--	13.7
Kansas	7.3	--	7.3	63.6	51.7	--	12.0	--	--	18.0
Nebraska	--	--	--	234.3	234.3	--	--	--	--	73.8
Iowa	21.5	15.1	6.5	187.7	184.7	--	--	--	3.0	48.8
Western Interior TOTAL	349.9	226.4	123.6	1,651.7	1,619.9	--	28.9	--	3.0	448.5
Texas	1,109.6	--	1,109.6	2,264.5	2,232.8	--	18.1	--	3.6	616.2
Louisiana	--	--	--	20.4	20.4	--	--	--	--	4.5
Arkansas	--	--	--	194.8	194.8	--	--	--	--	45.1
Texas TOTAL	1,109.6	--	1,109.6	2,479.7	2,448.0	--	18.1	--	13.6	665.8

TABLE F-15

REGIONAL COAL PRODUCTION AND USE SUMMARIES
STATE DETERMINATION ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
(100,000 tons)
(Continued)

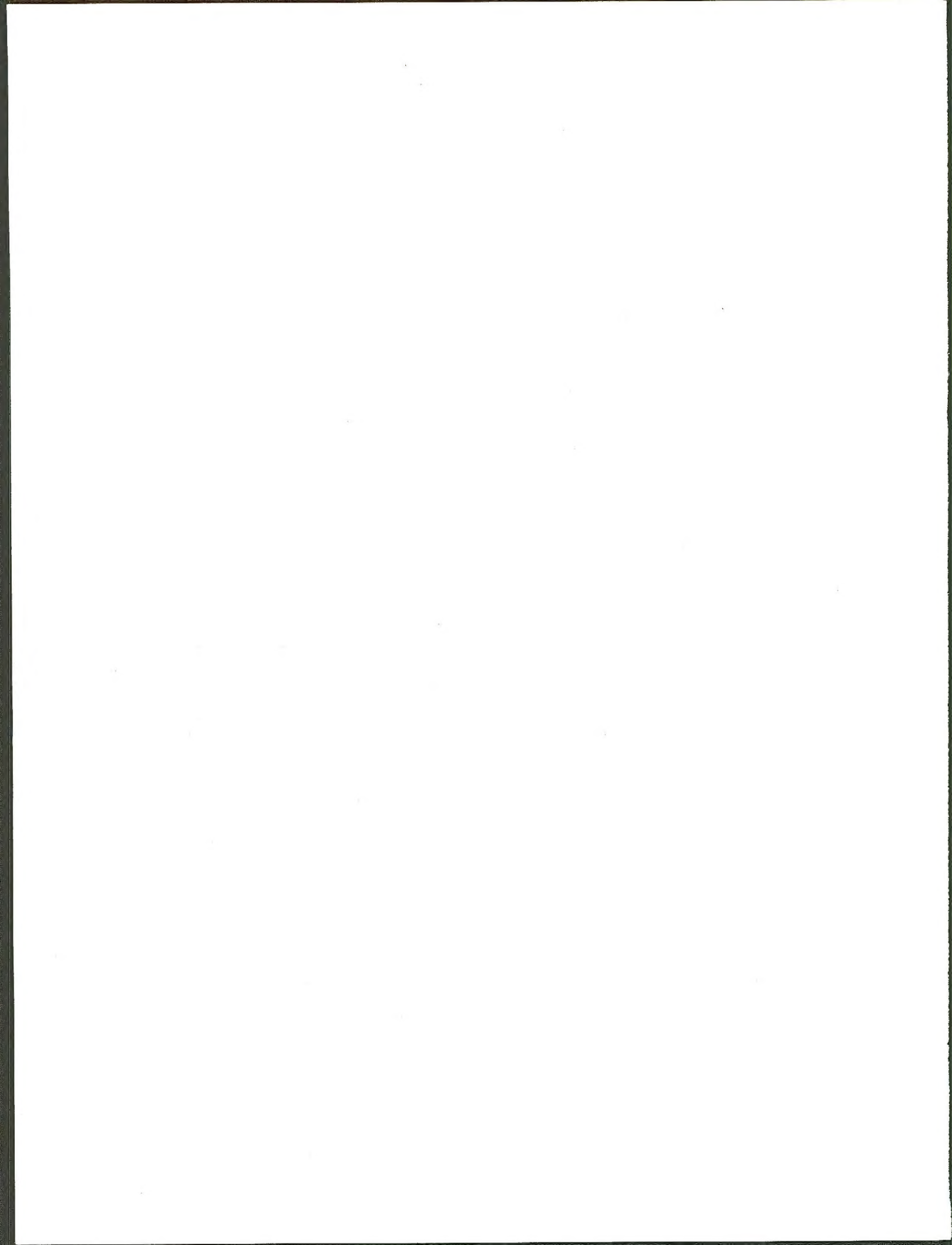
REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Montana	1,470.0	--	1,470.0	192.6	109.4	--	83.2	--	--	177.1
Wyoming	1,221.0	--	1,221.0	73.2	14.8	58.3	--	--	--	123.6
Powder River TOTAL	2,691.0	--	2,691.0	265.8	124.2	58.3	83.2	--	--	300.7
Montana	5.0	--	5.0	17.3	2.0	--	15.3	--	--	6.6
North Dakota	520.0	--	520.0	274.6	196.3	78.3	--	--	--	102.8
South Dakota	19.0	--	19.0	160.1	160.1	--	--	--	--	37.6
Fort Union TOTAL	544.0	--	544.0	452.0	358.4	78.3	15.3	--	--	147.0
Wyoming	424.0	--	424.0	83.9	27.1	56.8	--	--	--	55.8
Colorado	204.0	81.6	122.4	--	--	--	--	--	--	30.1
Idaho	--	--	--	90.3	90.3	--	--	--	--	21.3
Utah	--	--	--	8.3	8.3	--	--	--	--	2.1
Green River-Hams Fork TOTAL	628.0	81.6	546.4	182.5	125.7	56.8	--	--	--	109.3
Colorado	68.0	33.3	34.7	273.1	250.2	--	--	--	22.9	89.4
New Mexico	35.0	35.0	--	7.9	7.9	--	--	--	--	11.1
Denver-Raton Mesa TOTAL	103.0	68.3	34.7	281.0	258.1	--	--	--	22.9	100.5
Colorado	77.0	62.4	14.7	--	--	--	--	--	--	20.7
Utah	291.0	256.1	34.9	208.8	184.2	--	--	--	24.9	102.4
Uinta-Southwestern Utah TOTAL	368.0	318.5	49.6	208.8	184.2	--	--	--	24.9	123.1
New Mexico	613.0	6.1	606.9	123.7	68.2	55.5	--	--	--	87.0
Colorado	17.0	10.0	7.0	--	--	--	--	--	--	13.8
Utah	--	--	--	8.3	8.3	--	--	--	--	1.8
San Juan River TOTAL	630.0	16.1	613.9	132.0	76.3	55.5	--	--	--	102.6

TABLE F-15

REGIONAL COAL PRODUCTION AND USE SUMMARIES
 STATE DETERMINATION ALTERNATIVE, 1990 MEDIUM PRODUCTION LEVEL ^(a)
 (100,000 tons)
 (Concluded)

REGION/STATES	PRODUCTION	DEEP MINED	SURFACE MINED	TOTAL CONSUMPTION	STEAM GENERATION	SYNTHETIC HI-BTU GAS	SYNTHETIC LOW-BTU GAS	LIQUEFAC-TION	METALLURGICAL COKE	TOTAL COAL-RELATED POPULATION
Arizona	140.8	--	140.8	276.8	204.5	72.5	--	--	--	73.1
California	--	--	--	138.2	110.6	--	--	--	27.6	29.5
Nevada	--	--	--	11.0	11.0	--	--	--	--	2.9
Oregon/Washington	--	--	--	245.0	245.0	--	--	--	--	53.8
Other West	140.8	--	140.8	671.0	571.1	72.5	--	--	27.6	159.3
SUBTOTAL										
Connecticut/Rhode Island/Massachusetts	--	--	--	92.0	92.0	--	--	--	--	20.4
Delaware/New Jersey	--	--	--	38.0	38.0	--	--	--	--	9.1
Florida	--	--	--	348.6	348.6	--	--	--	--	77.2
Maine/New Hampshire/Vermont	--	--	--	23.0	23.0	--	--	--	--	5.1
Michigan	--	--	--	518.0	452.7	--	--	--	65.3	109.5
Minnesota/Wisconsin	--	--	--	334.3	313.9	--	--	--	20.4	76.9
Mississippi	--	--	--	24.5	24.5	--	--	--	--	6.0
New York	--	--	--	457.0	343.2	--	--	--	113.8	92.6
North Carolina/South Carolina	--	--	--	214.0	214.0	--	--	--	--	49.6
Other East	--	--	--	2,049.4	1,849.9	--	--	--	199.5	446.4
SUBTOTAL										
OTHER U.S. - TOTALS	140.8	--	140.8	2,720.4	2,421.0	72.5	--	--	227.1	605.7
EASTERN U.S. TOTALS	9,920.8	7,006.5	2,914.4	9,946.4	8,824.6	--	177.5	59.5	884.8	4,141.6
WESTERN U.S. TOTALS	4,964.0	484.5	4,479.6	1,522.1	1,126.9	248.9	98.5	--	47.8	883.2
U.S. TOTALS	15,025.6	7,491.0	7,534.8	14,188.9	12,372.5	321.4	276.0	59.5	1,159.7	5,630.5

(a) Data in 100,000 tons of coal; coal-related population in thousands of people. Data derived from U.S. Department of the Interior, Computerized Impact Estimation Program (CIEP).



APPENDIX G

CHANGE IN COAL-RELATED SOCIO-ECONOMIC CHARACTERISTICS FOR COAL PRODUCING REGIONS

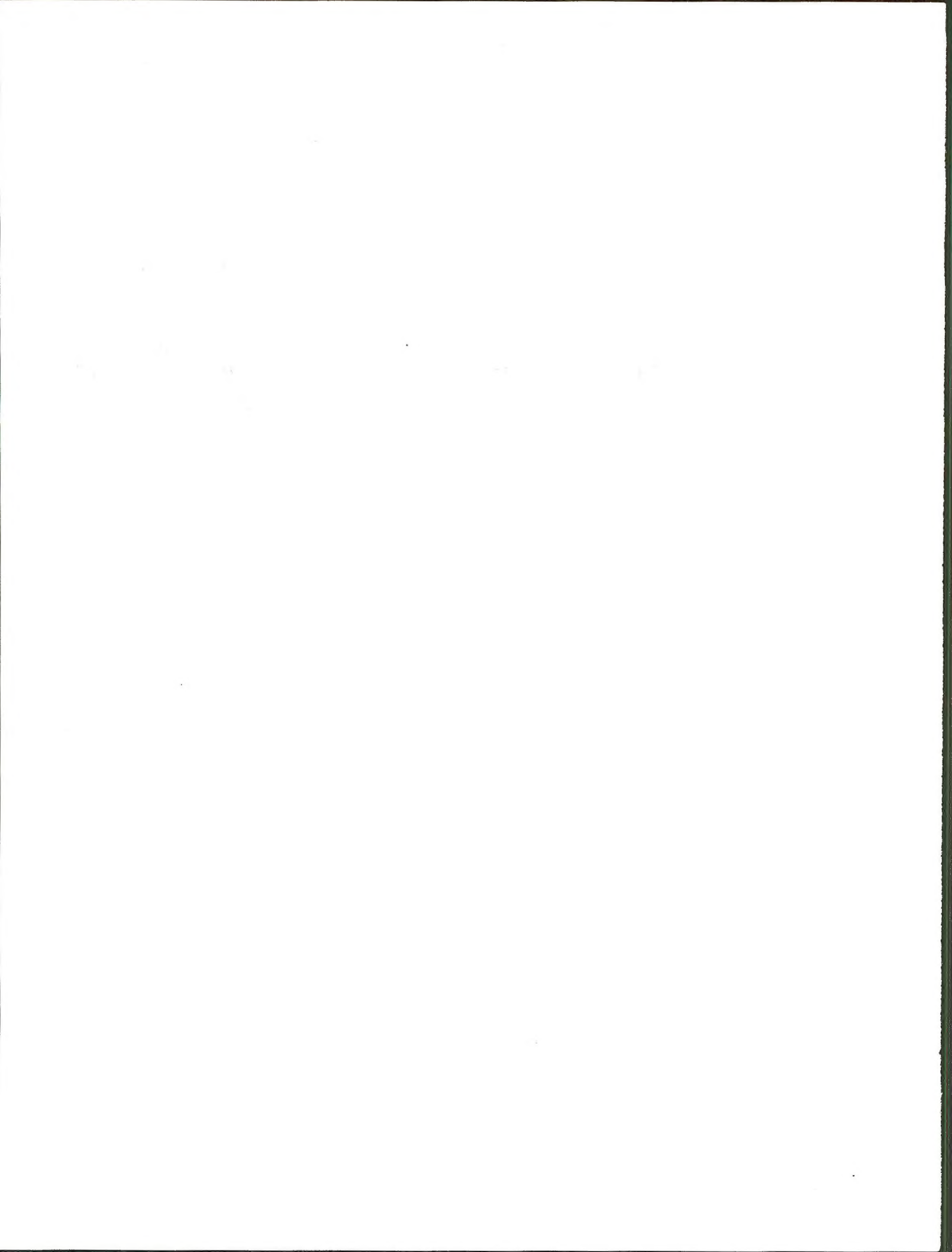


TABLE G-1
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE^(a)
1985 LOW LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	123552	27181	1461	124	618	41143	15	11	321	259	247
Central Appalachian	14892	3276	176	15	74	4959	2	1	39	31	30
Southern Appalachian	37653	8284	445	38	188	12539	5	3	98	79	75
Eastern Interior	176220	38768	2084	176	881	58681	21	15	458	370	352
Western Interior	65821	14481	779	66	329	21918	8	6	171	138	132
Texas	121767	26789	1440	122	609	40549	15	10	317	256	244
Powder River	79698	17533	943	80	398	26539	10	7	207	167	159
Green River-Hams Fork	21145	4652	250	21	106	7041	3	2	55	44	42
Fort Union	14662	3226	173	15	73	4883	2	1	38	21	29
San Juan River	5896	1297	70	6	29	1963	1	1	15	12	12
Uinta-Southwestern Utah	21160	4655	250	21	106	7046	3	2	55	44	42
Denver-Raton Mesa	16019	3524	189	16	80	5334	2	1	42	34	32

^(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-2
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE (a)
1990 LOW LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	-12628	-2778	-149	-13	-63	-4205	-2	-1	-33	-27	-25
Central Appalachian	18284	4022	216	18	91	6088	2	2	48	38	37
Southern Appalachian	-2167	-477	-26	-2	-11	-722	0	0	-6	-5	-4
Eastern Interior	158809	34938	1878	159	794	52883	19	13	413	333	318
Western Interior	16172	3558	191	16	81	5385	2	1	42	34	32
Texas	57237	12592	697	57	286	19060	7	5	149	120	114
Powder River	31707	6975	375	32	159	10558	4	3	82	67	63
Green River-Hams Fork	25138	5530	297	25	126	8371	3	2	65	53	50
Fort Union	21787	4793	258	22	109	7255	3	2	57	46	44
San Juan River	18615	4095	220	19	93	6199	2	2	48	39	37
Uinta-Southwestern Utah	22277	4901	263	22	111	7418	3	2	58	47	45
Denver-Raton Mesa	23925	5263	283	24	120	7967	3	2	62	50	48

(a) Represents change in coal related socioeconomic characteristic between 1985 and 1990.

TABLE G-3
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE ^(a)
1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	137276	30201	1624	137	686	45713	16	12	257	288	275
Central Appalachian	30498	6710	361	30	162	10156	4	3	79	64	61
Southern Appalachian	87980	19356	1041	88	440	29297	11	7	229	185	176
Eastern Interior	184987	40697	2188	185	925	61601	22	16	481	388	370
Western Interior	99756	21946	1180	100	499	33219	12	8	269	209	200
Texas	182345	40116	2157	182	912	60721	22	15	474	383	365
Powder River	112281	24702	1328	112	561	37390	13	10	292	236	225
Green River-Hams Fork	45364	9980	537	45	227	1406	5	4	118	95	91
Fort Union	22435	4936	265	22	112	7471	3	2	58	47	45
San Juan River	12755	2806	151	13	64	4247	2	1	33	27	26
Uinta-Southwestern Utah	42233	9291	500	42	211	14064	5	4	110	89	84
Denver-Raton Mesa	25617	5636	303	26	128	8531	3	2	67	54	51

^(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-4
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE^(a)
1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	108385	23845	1282	108	542	36092	13	9	282	228	217
Central Appalachian	76862	16910	909	77	384	25595	9	7	200	161	154
Southern Appalachian	26739	4883	316	27	134	8904	3	2	70	56	53
Eastern Interior	263608	57994	3118	264	1318	87782	32	22	685	554	527
Western Interior	150384	33084	1779	150	732	50078	18	13	391	316	301
Texas	259427	57074	3068	259	1297	86389	31	22	675	545	519
Powder River	91106	20043	1078	91	456	30338	11	8	237	191	182
Green River-Hams Fork	24016	5283	284	24	120	7997	3	2	62	50	48
Fort Union	60200	13244	712	60	301	20047	7	5	157	126	120
San Juan River	44293	9745	524	44	221	14750	5	4	115	93	89
Uinta-Southwestern Utah	37062	8154	438	37	185	12342	4	3	96	78	74
Denver-Raton Mesa	38709	8516	458	39	194	12890	5	3	101	81	77

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-5
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE^(a)
1985 HIGH LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	149236	32832	1765	149	746	49696	18	13	388	313	298
Central Appalachian	-6808	-1498	-81	-7	-34	-2267	-1	-1	-18	-14	-14
Southern Appalachian	116688	25671	1380	117	583	38857	14	10	303	245	233
Eastern Interior	157314	34609	1861	157	787	52306	19	13	409	330	315
Western Interior	106146	23352	1255	106	531	35347	13	9	276	223	212
Texas	176745	38884	2091	177	884	58856	21	15	460	271	353
Powder River	157360	34619	1861	157	787	52401	19	13	409	330	315
Green River-Hams Fork	58640	12901	694	59	293	19527	7	5	152	123	117
Fort Union	51760	11387	612	52	259	17236	6	4	135	109	104
San Juan River	30268	6659	358	30	151	10079	4	3	79	64	61
Uinta-Southwestern Utah	65979	14515	780	66	330	21971	8	6	172	139	132
Denver-Raton Mesa	36103	7943	427	36	181	12022	4	3	94	76	72

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-6
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE NO NEW LEASING ALTERNATIVE^(a)
1990 HIGH LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	91667	20167	1084	92	458	30525	11	8	238	193	183
Central Appalachian	96951	21329	1147	97	485	32285	12	8	252	204	194
Southern Appalachian	33002	7260	390	33	165	10990	4	3	86	69	66
Eastern Interior	225073	49516	2662	225	1125	74949	27	19	585	473	450
Western Interior	140286	30863	1659	140	701	46715	17	12	365	295	281
Texas	242301	53306	2866	242	1212	80686	29	21	630	509	485
Powder River	59782	13152	707	60	299	19907	7	5	155	126	120
Green River-Hams Fork	20941	4607	248	21	105	6973	3	2	54	44	42
Fort Union	52117	11466	616	52	261	17355	6	4	136	109	104
San Juan River	38015	8363	450	38	190	12659	5	3	99	80	76
Uinta-Southwestern Utah	38296	8426	453	28	191	12753	5	3	100	80	77
Denver-Raton Mesa	28886	6355	342	29	144	9619	3	2	75	61	58

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-7
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE^(a)
 1985 LOW LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	123542	27179	1461	124	618	41140	15	11	321	259	247
Central Appalachian	14800	3256	175	15	74	4928	2	1	38	31	30
Southern Appalachian	37602	8273	445	38	188	12522	5	3	98	79	75
Eastern Interior	176103	38743	2083	176	881	58642	21	15	458	370	352
Western Interior	65576	14427	776	66	328	21837	8	6	170	138	131
Texas	121859	26809	1441	122	609	40579	15	10	317	256	244
Powder River	79667	17527	942	80	398	26529	10	7	207	167	159
Green River-Hams Fork	21124	4647	250	21	106	7034	8	2	55	44	42
Fort Union	17243	3793	204	17	86	5742	2	1	45	36	34
San Juan River	5890	1296	70	6	29	1962	1	1	15	12	12
Uinta-Southwestern Utah	21145	4652	250	21	106	7041	3	2	55	44	42
Denver-Raton Mesa	15973	3514	189	16	80	5319	2	1	42	34	32

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE C-8
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE (a)
1990 LOW LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	-4258	-937	-50	-4	-21	-1418	-1	0	-11	-9	-9
Central Appalachian	18941	4167	224	19	95	6307	2	2	49	40	38
Southern Appalachian	-1719	-378	-30	-2	-9	-572	0	0	-4	-4	-3
Eastern Interior	158503	34871	1875	159	793	52781	10	13	412	333	317
Western Interior	17350	3817	205	17	87	5778	2	1	45	36	35
Texas	56518	12434	668	57	283	18821	7	5	147	119	113
Powder River	32365	7120	282	32	162	10777	4	3	84	68	65
Green River-Hams Fork	28540	6279	338	29	143	9504	3	2	74	50	57
Fort Union	19146	3992	215	18	91	6043	2	2	47	38	36
San Juan River	19722	4339	233	20	99	6567	2	2	51	41	39
Uinta-Southwestern Utah	24373	5362	288	24	122	8116	3	2	63	51	49
Denver-Raton Mesa	24954	5490	295	25	125	8310	3	2	65	52	50

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-9
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE (a)
 1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	137042	30149	1621	137	685	45635	16	12	356	288	274
Central Appalachian	28458	6261	337	28	142	9477	3	2	74	60	57
Southern Appalachian	83762	18428	991	84	419	27893	10	7	218	176	168
Eastern Interior	188929	41564	2235	189	945	62913	23	16	491	397	378
Western Interior	93896	20647	111	94	469	31267	11	8	244	197	188
Texas	184304	40547	2180	184	922	61373	22	16	479	387	369
Powder River	112924	24843	1336	113	565	37504	14	10	294	237	226
Green River-Hams Fork	48623	10697	575	49	243	16192	6	4	126	102	97
Fort Union	25179	5539	298	25	126	8384	3	2	65	53	50
San Juan River	12969	2853	153	13	65	4319	2	1	34	27	26
Uinta-Southwestern Utah	43258	9517	512	43	216	14405	5	4	112	91	87
Denver-Raton Mesa	26780	5892	317	27	134	8918	3	2	70	56	54

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-10
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE (a)
1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	110426	24294	1306	110	552	36772	13	9	287	232	221
Central Appalachian	71462	15726	845	71	257	23803	9	6	186	150	143
Southern Appalachian	30391	6686	359	30	152	10120	4	3	79	64	61
Eastern Interior	241418	53112	2855	241	1207	80392	29	21	628	507	482
Western Interior	149848	32967	1772	150	749	49899	18	13	390	315	300
Texas	233024	51265	2756	233	1165	77597	28	20	606	489	466
Powder River	162450	35739	1921	162	812	54096	19	14	422	341	326
Green River-Hams Fork	36312	7989	429	36	182	12092	4	3	94	75	73
Fort Union	50597	11131	598	51	263	16849	6	4	132	106	101
San Juan River	37271	8200	441	37	186	12411	4	3	97	78	75
Uinta-Southwestern Utah	28045	6170	332	28	140	9339	3	2	73	59	56
Denver-Raton Mesa	36536	8038	432	37	183	12167	4	3	95	77	73

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-11
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE^(a)
 1985 HIGH LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	148262	32618	1754	148	741	29371	18	13	385	311	297
Central Appalachian	-11449	-2519	-135	-11	-57	-3813	-1	-1	-30	-24	-23
Southern Appalachian	113730	25021	1345	114	569	37872	14	10	296	239	227
Eastern Interior	143779	31631	1701	144	719	47878	17	12	374	302	288
Western Interior	116448	25619	1377	116	582	28777	14	10	303	245	233
Texas	162761	35807	1925	163	814	54199	20	14	423	342	326
Powder River	172818	38020	2044	173	864	57548	21	15	449	363	346
Green River-Hams Fork	76842	16904	909	77	384	25588	9	7	200	161	154
Fort Union	52448	11539	620	52	262	17465	6	4	136	110	105
San Juan River	30610	6734	362	31	153	10193	4	3	80	64	61
Uinta-Southwestern Utah	67106	14763	794	67	336	22346	8	6	174	141	134
Denver-Raton Mesa	36898	8118	436	37	184	12287	7	3	96	77	74

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-12
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERRED PROGRAM ALTERNATIVE (a)
 1990 HIGH LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	372305	81907	4404	372	1862	123977	45	32	968	782	745
Central Appalachian	176041	38729	2082	176	880	58622	21	15	458	370	352
Southern Appalachian	104693	23032	1238	105	523	34863	13	9	272	220	209
Eastern Interior	352236	77492	4166	352	1761	117295	42	30	916	740	704
Western Interior	171049	37631	2023	171	855	56959	21	15	445	350	342
Texas	314813	69259	3724	315	1574	104833	38	27	819	661	630
Powder River	243030	53467	2875	243	1215	80929	29	21	632	510	486
Green River-Hams Fork	43330	9533	512	43	217	14429	5	4	113	91	87
Fort Union	44166	9717	522	44	221	14707	5	4	115	93	88
San Juan River	58237	12812	589	58	291	19393	7	5	151	122	116
Uinta-Southwestern Utah	43722	9619	517	44	219	14560	5	4	114	92	87
Denver-Raton Mesa	59864	13170	708	60	299	19936	7	5	156	126	120

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-13
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERENCE RIGHT PROGRAM ALTERNATIVE (a)
 1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	127306	28007	1506	127	637	42393	15	11	331	267	255
Central Appalachian	30238	6642	358	30	151	10069	4	3	79	63	60
Southern Appalachian	84395	18567	998	84	422	28103	10	7	219	177	169
Eastern Interior	184283	40542	2180	184	921	61366	22	16	479	387	369
Western Interior	92126	20268	1090	92	461	30678	11	8	240	193	184
Texas	180815	39779	2139	181	904	60211	22	15	470	380	362
Powder River	112363	24720	1329	112	562	37417	13	10	292	236	226
Green River-Hams Fork	46634	10260	552	47	233	15529	6	4	121	98	93
Fort Union	25189	5542	298	25	126	8388	3	2	65	53	50
San Juan River	12699	2794	150	13	63	4229	2	1	33	27	25
Uinta-Southwestern Utah	42728	9400	505	43	214	14228	5	4	111	90	85
Denver-Raton Mesa	26714	5877	316	27	134	8895	3	2	69	56	53

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-14
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE PREFERENCE RIGHT PROGRAM ALTERNATIVE (a)
 1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	121400	26708	1436	121	607	40426	15	10	316	255	243
Central Appalachian	79075	17397	935	70	395	26332	9	7	206	166	158
Southern Appalachian	33425	7354	395	33	167	11131	4	3	87	70	67
Eastern Interior	236456	52020	2797	236	1182	78740	28	20	615	407	473
Western Interior	147477	32445	1744	147	737	49110	18	13	383	310	295
Texas	252042	55449	2981	252	1260	83930	30	21	655	529	504
Powder River	126679	27869	1498	127	633	42184	15	11	329	266	253
Green River-Hams Fork	22389	4926	275	22	112	7456	3	2	58	47	45
Fort Union	54947	12088	650	55	275	18297	7	5	143	115	110
San Juan River	41601	9152	492	42	208	13853	5	4	108	87	83
Uinta-Southwestern Utah	29121	6407	344	29	146	9697	3	2	76	61	58
Denver-Raton Mesa	36200	7964	428	36	181	12055	4	3	94	76	72

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-15
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE SHORT TERM PROGRAM ALTERNATIVE ^(a)
 1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	127229	27990	1505	127	636	42367	15	11	331	267	254
Central Appalachian	29192	6422	345	29	146	9721	4	2	76	61	58
Southern Appalachian	86006	18921	1017	86	430	28640	10	7	224	181	172
Eastern Interior	185721	40859	2197	186	929	61845	22	16	483	390	371
Western Interior	93248	20515	1103	93	466	31052	11	8	242	196	186
Texas	181968	40033	2152	182	910	60595	22	15	473	382	364
Powder River	112572	24766	1331	113	563	37487	14	10	293	236	225
Green River-Hans Fork	46084	10138	545	46	230	15346	6	4	120	97	92
Fort Union	25214	5547	298	25	126	8396	3	2	66	53	50
San Juan River	12699	2794	150	13	63	4229	2	1	33	27	25
Uinta-Southwestern Utah	42585	9369	504	43	213	14181	5	4	111	89	85
Denver-Raton Mesa	26739	5883	316	27	134	8904	3	2	70	56	53

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-16
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE SHORT TERM PROGRAM ALTERNATIVE^(a)
 1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	121778	26791	1440	122	609	40552	15	10	317	256	244
Central Appalachian	76551	16841	905	77	383	25491	9	7	199	161	153
Southern Appalachian	29830	6563	353	30	140	9933	4	3	78	63	60
Eastern Interior	255933	56305	3027	256	1280	85226	31	22	665	537	512
Western Interior	151398	33308	1791	151	757	50416	18	13	304	318	303
Texas	351068	55235	2970	251	1255	84606	30	21	653	527	502
Powder River	98110	21560	1159	98	490	32634	12	8	255	206	195
Green River-Hams Fork	24286	5343	287	26	121	8087	3	2	63	51	49
Fort Union	57436	12636	679	56	387	19126	7	5	149	212	115
San Juan River	43590	9590	516	44	218	14515	5	4	113	92	87
Uinta-Southwestern Utah	34425	7573	407	34	172	11464	4	3	90	72	69
Denver-Raton Mesa	36006	7921	426	36	180	11990	4	3	94	76	72

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-17
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR MEET INDUSTRY NEEDS ALTERNATIVE^(a)
 1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	1226679	27869	1498	127	633	42184	15	11	329	266	253
Central Appalachian	12413	2731	147	12	62	4134	1	1	32	26	25
Southern Appalachian	93692	20612	1108	94	468	31199	11	8	244	197	187
Eastern Interior	172910	38049	2045	173	865	57579	21	15	450	363	346
Western Interior	93248	20515	1103	93	466	31052	11	8	242	196	186
Texas	173267	38119	2049	173	866	57698	21	15	450	364	347
Powder River	125409	27590	1483	125	627	41761	15	11	326	263	251
Green River-Hams Fork	67692	14892	801	68	338	22541	8	6	176	142	135
Fort Union	29417	6472	248	29	147	9796	4	3	76	62	59
San Juan River	16116	3546	191	16	81	5367	2	1	42	34	32
Uinta-Southwestern Utah	50352	11077	596	50	252	16767	6	4	131	106	101
Denver-Raton Mesa	28652	6303	339	29	143	9541	3	2	74	60	57

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-18
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE MEET INDUSTRY NEEDS ALTERNATIVE (a)
 1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	120564	27524	1426	121	503	40148	14	10	313	253	241
Central Appalachian	85440	18797	1011	85	427	28452	10	7	222	179	171
Southern Appalachian	31594	6951	374	32	158	10521	4	3	82	66	63
Eastern Interior	206014	45323	2437	206	1030	68603	25	18	536	433	412
Western Interior	152010	33442	1978	152	750	50619	18	13	395	319	304
Texas	222467	48943	2631	222	1112	74081	27	19	478	467	445
Powder River	184395	40567	2181	184	922	61404	22	16	479	387	369
Green River-Hams Fork	34711	7636	411	35	174	11559	4	3	90	73	69
Fort Union	56395	12407	667	56	382	18780	7	5	147	118	113
San Juan River	41529	9136	491	42	208	13829	5	4	108	87	83
Uinta-Southwestern Utah	34639	7621	410	35	173	11535	4	3	90	72	69
Denver-Raton Mesa	32752	7205	387	33	164	10906	4	3	85	69	66

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-19
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE DOE PRODUCTION PROJECTIONS ALTERNATIVE (a)
 1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	137047	30150	1621	137	684	45637	16	12	356	288	275
Central Appalachian	27423	6033	324	27	137	9132	3	2	71	58	55
Southern Appalachian	74072	16296	876	74	370	24666	9	6	193	156	148
Eastern Interior	177010	38942	3094	177	885	58944	21	15	460	372	354
Western Interior	100429	22094	1188	100	502	33443	12	9	261	211	201
Texas	178250	39215	2108	178	891	59356	21	15	463	374	356
Powder River	112383	24724	1329	112	562	37424	13	10	292	236	225
Green River-Hams Fork	67167	14777	792	67	336	22367	8	6	175	141	134
Fort Union	18355	4038	217	18	92	6112	2	2	48	39	37
San Juan River	9236	2032	109	9	46	3076	1	1	24	19	18
Uinta-Southwestern Utah	38444	8458	455	38	192	12802	5	3	100	81	77
Denver-Raton Mesa	30620	6736	362	31	153	10197	4	3	80	64	61

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-20
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE DOE PRODUCTION PROJECTIONS ALTERNATIVE^(a)
 1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	115122	25327	1362	115	576	38336	14	10	299	242	230
Central Appalachian	71818	15800	849	72	359	23915	9	6	187	151	144
Southern Appalachian	18049	3971	213	18	90	6019	2	2	47	38	36
Eastern Interior	252582	55568	2988	253	1263	84110	30	21	657	530	505
Western Interior	138873	30552	1643	139	594	46245	17	12	361	292	278
Texas	234630	51619	2775	236	1173	78132	28	20	610	493	469
Powder River	160604	35393	1900	161	803	53481	19	14	418	337	321
Green River-Hams Fork	34073	7496	403	34	170	11346	4	3	89	72	68
Fort Union	39979	8795	473	40	200	13313	5	3	104	84	80
San Juan River	39214	8627	464	39	196	13058	5	3	102	82	78
Uinta-Southwestern Utah	10343	2275	122	10	52	3444	1	1	27	22	21
Denver-Raton Mesa	20349	4477	241	20	102	6776	2	2	53	43	41

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

TABLE G-21
COAL PRODUCING REGIONS
SOCIOECONOMIC CHARACTERISTICS FOR THE STATE DETERMINATION ALTERNATIVE (a)
1985 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	126607	27854	1498	127	633	42160	15	11	329	266	253
Central Appalachian	38092	8380	451	38	190	12685	5	3	99	80	76
Southern Appalachian	77505	17051	917	78	388	25809	9	7	202	163	155
Eastern Interior	192525	42355	2277	193	963	64111	23	16	501	404	385
Western Interior	121166	26656	1433	121	606	40348	15	10	315	254	242
Texas	194228	42730	2297	194	971	64678	23	17	505	408	288
Powder River	100592	22130	1190	101	503	33497	12	9	262	211	201
Green River-Hams Fork	35527	7816	420	36	178	11830	4	3	92	75	71
Fort Union	29401	6468	348	29	147	9791	4	2	76	62	59
San Juan River	17228	3790	204	17	86	5737	2	1	45	36	34
Uinta-Southwestern Utah	42626	9378	504	43	213	14194	5	4	111	90	85
Denver-Raton Mesa	27673	6088	327	28	138	9215	3	2	72	58	55

(a) Represents change in coal related socioeconomic characteristics between 1976 and 1985.

TABLE G-22
 COAL PRODUCING REGIONS
 SOCIOECONOMIC CHARACTERISTICS FOR THE STATE DETERMINATION ALTERNATIVE (a)
 1990 MEDIUM LEVEL

	POPULATION	SCHOOL ENROLLMENT	TEACHERS	PHYSICIANS	HOSPITAL BEDS	HOUSING UNITS	WATER MGD	WASTEWATER MGD	SOLID WASTE TPD	LAW ENFORCEMENT	FIRE PROTECTION
Northern Appalachian	133722	29419	1582	134	669	44529	16	11	348	281	267
Central Appalachian	87388	19225	1034	87	437	29100	10	7	227	184	175
Southern Appalachian	9394	2067	111	9	47	3128	1	1	24	20	19
Eastern Interior	329995	72599	3903	330	1650	109888	40	28	858	693	660
Western Interior	109650	24123	1297	110	548	37513	13	9	285	230	219
Texas	230663	50746	2728	231	1153	76811	28	20	600	484	461
Powder River	79667	17527	942	80	398	26529	10	7	207	167	159
Green River-Hams Fork	8430	1855	100	8	42	2807	1	1	22	18	17
Fort Union	54463	11982	644	54	272	18136	7	5	142	114	109
San Juan River	41891	9216	495	42	309	13950	5	4	109	88	84
Uinta-Southwestern Utah	23888	5255	283	24	119	7955	3	2	62	50	48
Denver-Raton Mesa	21972	7034	378	32	160	10647	4	3	83	67	64

(a) Represents change in coal related socioeconomic characteristics between 1985 and 1990.

APPENDIX H

IMPACT ESTIMATION METHODOLOGY

APPENDIX H

IMPACT ESTIMATION METHODOLOGY

H.1 INTRODUCTION

The Department of Energy's (DOE) National Coal Model (NCM) is designed to forecast coal production, consumption, and prices and to analyze coal-related public policy issues. It generates equilibrium solutions through a linear program formulation which balances the supply and demand for coal at minimum cost. The model has a high degree of resolution with 30 supply regions, 35 demand regions, up to 40 possible coal types and six consuming sectors. The model is capable of making both short-term and long-term annual projections under a variety of policy alternatives because it is data driven. This means that users of the model have the capability of changing such factors as region specifications, assumed inflation rates, or assumed growth rates in electricity sales through modifications in the data base; such factors are not a part of the model's structure. This built-in flexibility and high degree of resolution allows users to address public policy issues with a great deal of precision because the model can be tailored for the analysis to be done. In addition, the model offers analysts the capability of performing the sensitivity analyses needed to gauge the uncertainty surrounding a forecast [1].

The NCM has been used as the point of departure for determining the levels of activity in the various phases of the coal cycle.

An allocation algorithm has been employed to adjust the NCM outputs for use in the present analysis. This algorithm: (1) translates the 30 NCM coal production areas and 35 consumption areas to 41 production areas and 53 consumption areas; and (2) estimates interregional flows from the 41 production areas to the 53 consumption areas utilized in this environmental impact statement. This algorithm is further described in section H-2.

The third analytical tool employed in the impact analysis of this chapter is a computerized program developed for this environmental impact statement, the Coal Impact Estimation Program (CIEP). A detailed description of this program is presented in section H-3.

H.2 COAL PRODUCTION AND DEMAND PROJECTIONS

H.2.1 DOE Projections (Demand Assumptions)

Three levels were used to specify the DOE National Coal Model demand values—low, mid-range, and high. The level titles relate to expected coal consumption and the demand for western coal. Model runs for each level were made by DOE for 1985 and 1990, giving six possible level/year combinations. The levels relate to the following data elements [2]:

- Crude oil prices and availability.
- Gas prices and availability.

- Coal labor costs.
- Coal transportation costs.
- Electricity demand growth rates.
- Nuclear capacity.
- Air pollution control regulations and scrubber costs.
- Coal conversion regulations and industrial coal consumption.
- Synthetic fuel production.
- Local coal provisions.
- Federal leasing assumptions.

Each of these level specifications is described below. Tables H-1 and H-2 summarize the assumptions for each of the three levels for 1985 and 1990, respectively.

H.2.1.1 Crude Oil Prices and Availability. The oil prices for the 1985 low level were developed from the Project Independence Evaluation System (PIES) forecasting model. This forecast assumed crude oil at \$13 per barrel (1975 dollars). From this model price, it was forecast that prices for 0.9 percent sulfur residual oil in Texas would be \$2.30 per million Btu, while distillate would be \$2.70 per million Btu.

H.2.1.2 Gas Prices and Availability. Gas prices for the low levels (1985 and 1990) assumed a continuation of existing regulations. Prices and availabilities for 1985 were based on PIES forecast model output. Prices and availabilities for 1990 were based on the PIES mid-range trendline level (Series C) with natural gas regulation and \$13 per barrel oil (1975 dollars).

H.2.1.3 Coal Labor Costs. The mid-range levels (1985 and 1990) incorporated the terms of a recent United Mine Workers Association (UMWA) settlement. In addition, they assumed a real escalation in labor costs of one percent per year in the post-1980 period. The low level (1985 and 1990) was the same as the mid-range, except there was no labor cost escalation after 1980. The high level alternatives (1985 and 1990) were the same as the mid-range, except that there was a two percent annual real escalation in labor costs after 1980.

H.2.1.4 Coal Transportation Costs. The mid-range and high levels (1985 and 1990) reflect 1977 current Interstate Commerce Commission (ICC) rates, escalated at the assumed general inflation rate of 5.5 percent. The low case reflects 1977 ICC rates with a one percent annual real escalation.

H.2.1.5 Electricity Demand Growth Rates. Electricity growth rates for each level were as follows (percent/year) (in giga watts):

TABLE H-1
ASSUMPTIONS FOR
DOE'S 1985 REGIONAL COAL PRODUCTION LEVELS

	<u>High</u>	<u>Mid-Range</u>	<u>Low</u>
1. Crude Oil Prices in 1985 (\$1975)	\$20/bbl	\$15/bbl	\$13/bbl
2. Gas Prices in 1985 (\$1975)	Same as mid-range	Senate conferees proposal	Continuation of existing regulations
3. Coal Labor Costs	Same as mid-range except 2%/yr. real escalation after 1980	UMW settlement with 1%/yr. real escalation in the post-1980 period	Same as mid-range except zero real escalation after 1980
4. Transportation Costs	Same as mid-range	Current ICC rates escalated for inflation	1%/yr. real escalation over current rates
5. Electricity Growth Rate (1977-1985)	NERC forecast (5.8%/yr.)	4.6%/yr.	3.5%/yr.
6. Nuclear Capacity (1985)	101 GW	97 GW	84 GW
7. Environmental Regulations			
• Utilities	Same as mid-range	o 85% FGD in the East o 60% FGD on low sulfur coal	o 90% FGD on all new plants
• Industry	Same as mid-range	FGD on all new boilers greater than 25 MW	FGD on all new boilers greater than 5 MW

TABLE H-1 Continued

	<u>High</u>	<u>Mid-Range</u>	<u>Low</u>
8. Coal Conversion Regulations			
• Utilities	Same as mid-range	Regulatory Program passed by conference committee	Existing Regulations
• Industry	Same as mid-range	Boiler only oil/gas user tax and conference regulatory bill	Existing Regulations
9. Macro-economic Forecast (1975-1985)	Same as mid-range	DRI TRENDLONG	Same as mid-range
10. Synthetic Fuel Production (1985)	40 million tons	20 million tons	12 million tons
11. Exports (1985)	Same as mid-range	71 million tons	Same as tons

UMW : United Mine Workers
 NERC: National Electric Reliability Council
 GW : Giga Watt or 10⁹ watts
 FGD : Flue Gas Desulfurization
 ICC : Interstate Commerce Commission
 DRI : Data Resources Incorporated

SOURCE: Reference Number 1.

TABLE H-2

ASSUMPTIONS FOR
DOE's 1990 REGIONAL COAL PRODUCTION LEVELS

	<u>High</u>	<u>Mid-Range</u>	<u>Low</u>
1. Crude Oil Prices in 1990 (\$1975)	\$30/bbl	\$20/bbl	\$13/bbl
2. Gas Prices in 1990 (\$1975)	Same as mid-range	Senate conferee proposal	Continuation of existing regulations
3. Coal Labor Costs	Same as mid-range except 2%/yr. real escalation after 1980	UMW settlement with 1%/yr. real escalation in the post-1980 period	Same as mid-range except zero real escalation after 1980
4. Transportation Costs	Same as mid-range	Current ICC rates escalated for inflation	1%/yr. real escalation over current rates
5. Electricity Growth (1985-1990)	4.5%/yr.	4.0%/yr.	3.5%/yr.
6. Nuclear Capacity	181 GW	167 GW	150 GW
7. Environmental Regulations			
• Utilities	Same as mid-range	<ul style="list-style-type: none"> o 85% FGD in the East o 60% FGD on low sulfur coal 	90% FGD on all new plants
• Industry	Same as mid-range	<ul style="list-style-type: none"> o FGD on all new boilers 	FGD on all new boilers greater than 5 MW

TABLE H-2 Continued

	<u>High</u>	<u>Mid-Range</u>	<u>Low</u>
8. Coal Conversion Regulations			
• Utilities	Same as mid-range	Regulatory program passed by conference	Existing regulatory bill
• Industry	Same as mid-range	Boiler only oil/gas user tax & conference regulatory bill	Existing regulatory bill
9. Macro-economic Forecast (1985-1990)	Same as mid-range	DRI TRENDLONG	Same as mid-range
10. Synthetic Fuel Production (1990)	110 million tons	55 million tons	25 million tons
11. Exports (1990)	Same as mid-range	75 million tons	Same as mid-range

UMW : United Mine Workers
 NERC: National Electric Reliability Council
 GW : Giga Watt or 10⁹ watts
 FGD : Flue Gas Desulfurization
 ICC : Interstate Commerce Commission
 DRI : Data Resources Incorporated

SOURCE: Reference Number 1.

	Low	Mid-Range	High
1975-85	4.0	4.8	5.8
1985-90	3.5	4.0	4.5

For the 1985 mid-range levels, the regional distributions were developed from PIES Model Forecast 5, which had a 4.82 percent average national growth rate. The growth rate for each PIES region was assigned to each of the component U.S. Census regions. Where U.S. Census regions overlapped PIES regions, the growth rate for the U.S. Census region was developed as a weighted average.

The 1985 high level was based on the National Electric Reliability Council (NERC) forecast, which assumed an annual growth rate of 5.8 percent. This distribution was also based on NERC data, and in some cases was quite different from the PIES regional growth patterns.

The 1985 low alternative was developed from the mid-range level by scaling down the growth rates. This was done in two steps. First, each region's growth rate was scaled down by dividing by the ratio of the national growth rates; e.g., 4.82 percent/4.0 percent = 1.205. These new regional growth rates were then applied to the 1975 regional sales to project 1985 sales by region. The national total and implied growth rates were then computed. Since this national growth rate was slightly different than the 4.0 percent target, a second iteration was required. The new national growth rate was divided by 4.0 percent, and the quotient was divided into the regional growth rates. This process can be iterated until the national growth rate is not significantly different from the target of 4.0 percent.

The 1990 electricity demands were developed in a manner similar to that used in the 1985 low level. For the mid-range alternative, the 1985 mid-range regional totals were extended to 1990 by extrapolating regional growth rate by a factor of 1.205. The national total was computed and implicit growth rate determined. This new national growth rate was used as a base for a second iteration on changing the regional growth rates, and the process was repeated until the national growth rate of 4.0 percent was reached.

For the 1990 low and high levels, the process was the same. For each, the 1985 low and high regional totals were used as a base, and the growth rates scaled by the ratio of the 1985 national rate to the 1990 target national rate. The process was repeated until the national growth rates of 3.5 and 4.5 percent were reached.

H.2.1.5 Nuclear Capacity. Nuclear generating capacity for these levels was as follows (in giga watts):

	Low	Mid-Range	High
1985	84	97	101
1990	150	167	181

These capacity data were provided by DOE/EIA.

H.2.1.6 Air Pollution Control Regulations.

Best Available Control Technology (BACT) is defined as 90 percent SO₂ removal, except that partial scrubbing would be permitted if annual average SO₂ emissions were reduced to a specified floor:

Level	Floor
	(lb. SO ₂ /MMBtu)
Low-Range	0.2
Mid-Range	0.5
High-Range	0.5

The industrial BACT regulations vary by level as follows. All industrial facilities with greater than 25 MW capacity are subject to the regulations in the high and mid-range alternatives. Industrial facilities with capacity of 5 MW or greater are subject to BACT regulations in the low range level. These regulations were addressed in the industrial demand estimates [3].

H.2.1.7 Coal Conversion Regulations and Industrial Coal Consumption. For utilities, the low level assumed a continuation of existing regulations. Combined cycle systems were allowed anywhere. The mid-range and high levels assumed the regulatory program passed by the Conference Committee. Combined cycle systems were prohibited everywhere except in Southern California.

Industrial coal demand estimates for 1985 reflected the sum of baseline demand and incremental coal demand stimulated by alternative regulatory and incentive programs. The sources and assumptions for the baseline and coal conversion estimates were summarized for each level below.

Level	Baseline Demand	Coal Conversion
High-Range	Same as mid-range.	Same as mid-range.
Mid-Range	PIES Mid-Range/Trend-Long Level (1/14/78).	Boiler only oil/gas user tax and Conference regulatory bill.
Low-Range	PIES Mid-Range/Trend-Long Level (1/14/78).	Existing Regulations

1985 demand estimates by NCM region were provided for two sulfur classes and two ranks (bituminous and sub-bituminous)[3].

H.2.1.8 Synthetic Fuel Production. Coal demand for synthetics was based on DOE estimates. These estimates indicate demand (in 10^{12} Btu) by end-product (liquefaction, high-Btu gas, medium-Btu gas), NCM demand region, coal-type (bituminous – 11,000 Btu/lb., subbituminous – 9,000 Btu/lb., lignite – 7,000 Btu/lb.), year (1985 and 1990), and level (low, mid-range, high). Two adjustments were made to the original estimates. First, demand was aggregated across end-products, resulting in a single “synthetics” demand category. Second, demand from regions AN, KN, and TX were attributed to the coal-type most prevalent, so that each region is demanding only one coal-type (see Table H-3).

H.2.1.9 Local Coal Provisions. The Clean Air Act Amendments of 1977 included a “local coal” provision (now section 125 of the act), which would permit, under certain conditions, an order that locally or regionally available coal be used to comply with SIP requirements. Given that the fate of this provision was unclear, it was not included in any of the levels.

H.2.1.10 Federal Leasing Assumptions. For all three levels in both 1985 and 1990, it was assumed that the Federal Government would lease enough coal reserves such that the reserves cheapest to mine (regardless of ownership) would be mined first. This assumption has the effect on minimizing total national costs of coal production, transportation, and consumption.

H.2.2 Department of The Interior Production Projections

The establishment of production levels for this environmental statement was not based on any one computer run forecasting model or other single mechanical procedure. There was no one authoritative set of future projections or even method of projection readily available; hence, judgmental decisions were necessary. Accordingly, a number of sources of information were considered in forming these judgments. These sources include:

- Department of Energy (DOE) projections.
- Preliminary Department of the Interior regional environmental impact statements.
- Coal industry and government forecasts.
- Approved and pending mine plans.
- Current production levels.
- Contractually obligated production.

Based on these factors, the production levels shown in Tables H-4 and H-5 were developed. Precision at the level of tenths of a point (equivalent to 100,000 tons) does not have much absolute meaning. Such small changes in production levels are most significant in indicating expected relative changes in production levels among regions and, within a region, the expected direction of change in production from one alternative to another.

H.2.3 Allocation Algorithm and Constraints

The objective of the algorithm is to generate estimates of production and consumption on a regional basis when only limited information is provided about western coal production levels. The algorithm utilizes an origin/destination (O/D) coal flow matrix upon which are super-imposed predetermined

western coal production levels. The O/D matrix is restructured so that regional energy demands are satisfied and the level of coal consumption for each region identified. This algorithm uses a translation of the 30 National Coal Model (NCM) coal production areas and 35 consumption areas (see Table H-6) into 41 production areas and 53 consumption areas (see Table H-7).

The 35 NCM demand (consumption) areas consist primarily of multi-state areas. For example, the States of Alabama and Mississippi are combined to form the NCM consumption area “AM”. It was necessary to disaggregate this demand region to its component states in order to more accurately portray production, transportation, and consumption impacts.

Coal flows into multistate consuming areas were allocated among the individual states on the basis of population, projected level of coal demand by energy conversion facilities and existing patterns of coal consumption by industry and steam electric generation capacity. Specific data sources used for the disaggregation and allocation of coal flows were the U.S. Department of Commerce [4, 5] and the Edison Electric Institute, Annual Statistical Yearbook [6].

For example, in the specific case of Alabama and Mississippi, it was determined that, on the basis of the data sources and judgemental factors listed, the flows of coal into the NCM area would be distributed 95 percent to Alabama and 5 percent to Mississippi.

The major assumptions incorporated in the “ALLOCATE” algorithm governing consumption levels include:

- Fixed Btu demand within consuming areas. The level selected reflects national production at a low, medium, or high level.
- Coal flows (in Btus) remain constant for intrastate shipments.
- Tonnage levels of coal flows from origin to destination vary based upon a representative heat value for coal in the producing state.

For each management program alternative analyzed, consumption expressed as a demand for energy (heat value equivalent) was assumed to be fixed and represented a particular mix of energy using facilities within a consuming region (consistent with the NCM assumptions).

The assumption of coal flows remaining constant on an intrastate basis was made to incorporate the fact that local coal supplies represent a least cost source of coal. If under a given program alternative, coal production levels for a particular state decrease by a given percentage, only the levels of coal leaving the state would be reduced.

Under the various production levels and alternate leasing programs analyzed, specific levels of coal flows vary. Reduced flows from one producing area would be offset by increased flow from other areas. The heat value in millions of Btu per ton (MBtu/ton) of coal varies from mine to mine and from state to state. The actual tonnage flows from substitute producing states would be weighted by their relative average heat value. Accordingly, if the heat value per ton of coal from a substitute state is higher than the original supplying state, the actual tonnage flow from the substitute state would be lower.

TABLE H-3

PIES AND CORRESPONDING NCM DEMAND REGIONS

PIES DEMAND REGION (CENSUS REGIONS)	CORRESPONDING NCM DEMAND REGIONS
1. New England	MV MC
2. Mid-Atlantic	NU PJ WP
3. South Atlantic	WV VM CA GF SF
4. East North Central	ON OM OS IL IN MI WI
5. East South Central	EK WK ET WT AM
6. West North Central	DM IA MO KN
7. West South Central	AO TX
8. Mountain	MW CO UN AN
9. Pacific	WO CN CS

SOURCE: Reference Number 1.

TABLE H-4

WESTERN PROJECTED PRODUCTION LEVELS,
PREFERRED PROGRAM AND NO NEW LEASING ALTERNATIVE
(1985 and 1990)
(million tons)

REGION	PREFERRED LEASING PROGRAM			NO NEW LEASING		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
1985						
Fort Union	16.9	31.9	51.9	16.9	31.9	51.9
Powder River	150.0	205.0	300.0	150.0	204.8	275.0
Green River-Hams Fork	40.0	80.0	130.0	40.0	76.0	99.6
Uinta-Southwestern Utah	15.0	30.0	45.0	15.0	29.6	44.5
Denver Raton Mesa	2.0	5.0	10.0	2.0	5.0	10.0
San Juan River	15.0	25.0	40.0	15.0	24.8	39.7
1990						
Fort Union	21.9	41.9	81.9	21.9	51.0	94.9
Powder River	175.0	400.0	600.0	175.0	305.0	335.0
Green River-Hams Fork	70.0	120.0	175.0	66.5	98.7	119.0
Uinta Southwestern Utah	20.0	40.0	60.0	19.8	45.0	65.0
Denver-Raton Mesa	5.0	10.0	15.0	5.0	10.7	15.0
San Juan River	25.0	50.0	75.0	75.0	59.4	77.3

Source: Reference Number 33.

TABLE H-5

WESTERN PRODUCTION LEVELS, MID-LEVEL ALTERNATIVES
1985 and 1990
(million tons)

COAL REGION	PRLAs ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	STATE DETER- MINATION	MEET DOE TARGETS
1985	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Fort Union	31.9	31.9	36.9	37.4	21.9
Powder River	205.0	205.0	225.0	183.7	204.6
Green River- Hams Fork	77.9	77.0	112.0	57.5	112.0
Uinta-Southwestern Utah	30.0	29.7	35.0	29.4	26.4
Denver-Raton Mesa	5.0	5.0	6.0	7.5	6.0
San Juan River	24.8	24.8	30.0	32.0	22.1
1990	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Fort Union	47.4	50.6	51.9	54.4	22.5
Powder River	355.0	316.0	450.0	269.1	396.1
Green River- Hams Fork	101.0	104.2	150.0	62.8	149.5
Uinta-Southwestern Utah	42.0	44.8	51.0	36.8	28.3
Denver-Raton Mesa	10.5	10.6	10.0	10.3	7.5
San Juan River	54.9	58.4	60.0	63.0	57.2

Source: Derived from Reference Numbers 34 and 35.

TABLE H-6

NATIONAL COAL MODEL SUPPLY AND DEMAND REGIONS (a)

<u>30 NCM SUPPLY REGIONS</u>	<u>35 NCM DEMAND REGIONS</u>
Pennsylvania (PA)	Maine/Vermont/New Hampshire (MV)
Ohio (OH)	Massachusetts/Connecticut/Rhode Island (MC)
Maryland (MD)	New York, upstate (NU)
West Virginia, north (NV)	Pennsylvania, east/New Jersey/New York,
West Virginia, south (SV)	downstate (PJ)
Virginia (VA)	Pennsylvania, west (WP)
Kentucky, east (EK)	Virginia/Maryland/Delaware/D.C. (VM)
Tennessee (TN)	West Virginia (WV)
Alabama (AL)	North Carolina/South Carolina (CA)
Illinois (IL)	Georgia/Florida, north (GF)
Indiana (IN)	Florida, south (SE)
Kentucky, west (WK)	Ohio, north (ON)
Iowa (IA)	Ohio, central (OM)
Missouri (MO)	Ohio, south (OS)
Kansas (KS)	Illinois (IL)
Arkansas (AR)	Indiana (IN)
Oklahoma (OK)	Michigan (MI)
Texas (TX)	Wisconsin (WI)
North Dakota (ND)	Kentucky, east (EK)
South Dakota (SD)	Kentucky, west (WK)
Montana, east (EM)	Tennessee, east (ET)
Montana, west (WM)	Tennessee, west (WT)
Wyoming (WY)	Alabama/Mississippi (AM)
Colorado, north (CN)	North Dakota/South Dakota/Minnesota (DM)
Colorado, south (CS)	Iowa (IA)
Utah (UT)	Missouri (MO)
Arizona (AZ)	Kansas/Nebraska (KN)
New Mexico (NM)	Arkansas/Oklahoma/Louisiana (AO)
Washington (WA)	Texas (TX)
Alaska (AK)	Montana/Wyoming/Idaho (MW)
	Colorado (CO)
	Utah/Nevada (UN)
	Arizona/New Mexico (AN)
	Washington/Oregon (WO)
	California, north (CN)
	California, south (CS)

(a) SOURCE: Reference Number 36.

TABLE H-7
DEPARTMENT OF THE INTERIOR SUPPLY AND
DEMAND REGIONS

41 DOI SUPPLY REGIONS		53 DOI DEMAND REGIONS	
Alabama	Oregon-Washington	Alabama	Missouri
Arkansas-Western Interior	Pennsylvania	Arizona	Montana-Powder River
Arkansas-Texas Gulf	South Dakota	Arkansas-Western Interior	Montana-Fort Union
Colorado-Green River-Hams Fork	Tennessee-Central Appalachian	Arkansas-Texas	Nebraska
Colorado-San Juan River	Tennessee-Southern Appalachian	California	Nevada
Colorado-Uinta-Southwestern Utah	Texas	Colorado-Green River-Hams Fork	New Mexico-San Juan River
Colorado-Denver-Raton Mesa	Utah-Green River-Hams Fork	Colorado-San Juan River	New Mexico-Denver-Raton Mesa
Georgia	Utah-San Juan River	Colorado-Uinta-Southwestern Utah	New York
Idaho	Utah-Uinta-Southwestern Utah	Colorado-Denver-Raton Mesa	North Carolina-South Carolina
Illinois	Virginia	Connecticut-Massachusetts-Rhode Island	North Dakota
Indiana	West Virginia-Northern Appalachian	Delaware-New Jersey	Ohio
Iowa-Eastern Interior	West Virginia-Central Appalachian	Florida	Oklahoma
Iowa-Western Interior	Wyoming-Powder River	Georgia	Oregon-Washington
Kansas	Wyoming-Green River-Hams Fork	Idaho	Pennsylvania
Kentucky-Central Appalachian		Illinois	South Dakota
Kentucky-Eastern Interior		Indiana	Tennessee-Central Appalachian
Louisiana		Iowa-Eastern Interior	Tennessee-Southern Appalachian
Maryland		Iowa-Western Interior	Texas
Missouri		Kansas	Utah-Green River-Hams Fork
Montana-Powder River		Kentucky-Central Appalachian	Utah-San Juan River
Montana-Fort Union		Kentucky-Eastern Interior	Utah-Uinta-Southwestern Utah
Nebraska		Louisiana	Virginia
New Mexico San Juan River		Maine-New Hampshire-Vermont	West Virginia-Northern Appalachian
New Mexico Denver-Raton Mesa		Maryland	West Virginia-Central Appalachian
North Dakota		Michigan	Wyoming-Powder River
Ohio		Minnesota-Wisconsin	Wyoming-Green River
Oklahoma		Mississippi	

The allocation algorithm utilizes a multiplier concept to convert projected DOE production levels in western coal supply areas to the projected production level of each program alternative. By prespecifying coal production levels in each western region, and allowing production levels in non-western areas to "float" in response to the level of unsatisfied Btu demands in each consuming state, a new origin/destination matrix of coal tonnage flows was generated. When western coal production was constrained, demand was shifted to eastern producing areas. Since eastern coal has generally higher Btu content, the actual tonnage flows from the substitute supply states are directly proportional (on a MBtu/ton basis) with the prestrained flows from the original supply state. The new O/D matrices were also used to estimate coal consumption in each coal demand area for each alternative. Domestic coal consumption was estimated by subtracting DOE projected coal exports from designated exporting states. In developing the "ALLOCATE" algorithm, the following assumptions were used:

- 1.) The weighted MBtus/ton values were determined by using the heat value of each NCM coal category (see Table H-8).
- 2.) The following heat-values categories are defined in the NCM.

Coal Category	MBtus/Ton	Assumed MBtus per ton
Z	26	2
H	23-25.99	24.5
M	20-22.99	21.5
S	15-19.99	17.5
L	15	15

3.) Total tonnage shipped (by category) for each producing state was determined and expressed as a percent of total coal produced in that state.

4.) The category percentages were then multiplied by the MBtus/ton value for each coal category. The multiplication products were then summed to obtain a weighted MBtu/ton value for all coal shipments from a given state, as in Table H-9

5.) Western coal region production levels were determined exogenous to "Allocate". These levels were fixed and the output of the remaining coal producing areas allowed to 'float' in response to fixed Btu demand levels in each consuming area.

H.2.4 Transportation Assumptions (Modal Split)

The assumption was made that the majority of interstate coal movements would be by rail while a smaller volume of intrastate shipments would be transported in this way. The remainder of the intrastate movements would move by barge, highway, or slurry pipeline, depending on existing and projected transportation facilities of these types. Specific modal split information is presented in Table H-10.

Due to the dynamic nature of coal transportation, incorporation of the transportation sector in the analysis requires a methodological approach recognizing the inherent differences between static processes and dynamic flows. In contrast to the other phases of the coal cycle (i.e., production

and consumption), the characterization of coal flows in terms of tonnage does not result in a clear presentation of environmental residuals. The measure chosen to determine transportation environmental impact residuals is gross ton-miles generated as a result of transporting coal. In this context, gross ton-miles consists of the following components:

- Net ton-miles - weight of coal times distance moved.
- Tare ton-miles - weight of transportation equipment utilized times round trip distance from mine to destination and return.

The inclusion of tare weight recognizes the fact that trains, trucks, and barges which haul coal also generate environmental residuals during the return trip to the coal mine or loading facility. Within this context, the following additional assumptions were used:

- 1.) Modal Split Assumptions - Gross Ton Mile Estimation (see Figure H-1)
- 2.) Interstate Coal Flows - Total gross ton-miles were calculated on the basis of 100 percent movement by rail. This estimate was then adjusted for 1976 waterway coal transport as a percent of total coal moved. (Waterway transport was deducted from total gross ton-miles), and total slurry pipeline net ton mileage added to gross ton mile estimates to obtain a revised estimate of gross ton-miles.
- 3.) Intrastate Coal Flows
 - 75 percent moved by rail
 - 12 percent moved by truck - average truck haul assumed to be 20 tons moved over 75 mile distance.
 - 13 percent minemouth utilization
 - Barge transport estimate of gross ton mileage based on same rationale as interstate flows.
 - Slurry pipelines - constant quantity of coal transported for all alternatives analyzed.
 - Rail haul distance between origin and destination (intrastate and interstate) assumed to be 1.15 times short line distance to account for rail line circuitry.

H.2.4.1 Ton Mile Analysis - 1985 DOE Midlevel Consumption Estimates. The methodology developed to estimate the base case level of gross ton-mile per state consists of:

- 1) Identification of a representative origin/destination matrix for the 1985 DOE midlevel coal flows.
- 2) Identifying all coal flows, probable routes and length of route within each state between origin and destination.
- 3) Calculation of number of trips and coal tonnage flows within each state.
- 4) Combination of coal flow, distance and transport mode information.
- 5) Estimation of gross ton-mileage generated per state for the consumption level represented in the origin/destination matrix used.

Estimates of gross ton mileage per state are presented in Table H-11.

The distribution of gross ton-mileage per state for each program alternative was determined on the following basis:

- The 1985 DOE mid-level coal production consumption used was the base case.
- Production/consumption for each alternative was derived through use of the 'Allocate' program. This production/consumption was then divided by the base

TABLE H-8

WEIGHTED AVERAGE MBTUs/TON 1985 DOE MID-LEVEL PRODUCTION

GEOGRAPHIC UNITS	AVERAGE MBTU/TON
01 Alabama	25.0
04 Arizona	21.6
05(A) Arkansas (W. Int.)	26
05(B) Arkansas (Tx)	15
06 California	0
08(A) Colorado (G.R.)	22.7
08(B) Colorado (S.J.)	22.7
08(C) Colorado (Uinta)	22.7
08(D) Colorado (D-R)	22.7
09 Connecticut/Maryland/Rhode Island	0
10 Delaware/New Jersey	0
12 Florida	0
13 Georgia	25.0
16 Idaho	0
17 Illinois	22.7
18 Indiana	21.9
19(A) Iowa (E. Int.)	21.5
19(B) Iowa (W. Int.)	21.5
20 Kansas	24.5
21(A) Kentucky (C. App.)	25.5
21(B) Kentucky (E. Int.)	22.8
22 Louisiana	0
23 Maine/New Hampshire/Vermont	0
24 Maryland	25.6
26 Michigan	0
27 Minnesota/Wisconsin	0
28 Mississippi	0

TABLE H-8 (Continued)

GEOGRAPHIC UNITS	AVERAGE MBTU/TON
29 Missouri	21.5
30(A) Montana (P.R.)	15
30(B) Montana (F.U.)	17.5
31 Nebraska	24.5
32 Nevada	0
35(A) New Mexico (S.J.)	21.5
35(B) New Mexico (D.R.)	21.5
36 New York	0
37 North Carolina/South Carolina	0
38 North Dakota	15
39 Ohio	23.4
40 Oklahoma	21.1
41 Oregon/Washington	0
42 Pennsylvania	25.7
46 South Dakota	15
47(A) Tennessee (C.App.)	24.9
47(B) Tennessee (S. App.)	24.9
48 Texas	15
49(A) Utah (G.R.)	25.1
49(B) Utah (S.J.)	25.1
49(C) Utah (Uint)	25.1
51 Virginia	25.5
54(A) West Virginia (N. App.)	25.5
54(B) West Virginia (C. App.)	25.7
56(A) Wyoming (P.R.)	18.9
56(B) Wyoming (G.R.)	18.9

Source: Reference Number 48.

TABLE H-9

EXAMPLE OF WEIGHTED MBTU/TON CALCULATION

(1) Coal Category	(2) Production x 10 ⁶ Tons	(3) Avg. MBtu/Ton	(4) Production as % Total Production	(5) (4)x(3) Weighted MBtu/Ton
Z	109.8	26	83.3	21.658
H	<u>22.0</u>	<u>24.5</u>	<u>16.7</u>	<u>4.091</u>
	131.8		100.0	25.749 (MBtu/ton average)

TABLE H-10
SUMMARY OF TRANSPORTATION STATISTICS 1985 DOE MID LEVEL

CODE	REGION/STATE	Gross Ton Miles (In million ton miles)					Net Ton Miles (In million ton miles)				
		(a) TOTAL	% WATERWAY	% PIPELINE	% RAILROAD	% TRUCK	TOTAL	% WATERWAY	% PIPELINE	% RAILROAD	% TRUCK
01	Alabama	38980	0.05	0	0.94	0.01	22174	0.06	0	0.92	0.02
04	Arizona	16480	0	0.08	0.91	0.01	9882	0	0.14	0.86	0
05A	Arkansas	7205	0	0.28	0.72	0	4930	0	0.41	0.59	0
05B	Arkansas	17802	0	0.07	0.93	0	10570	0	0.12	0.88	0
06	California	7864	0	0	1.00	0	4428	0	0	1.00	0
08A	Colorado	5982	0	0	1.00	0	3368	0	0	1.00	0
08B	Colorado	5	0	0	1.00	0	3	0	0	1.00	0
08C	Colorado	893	0	0	1.00	0	503	0	0	1.00	0
08D	Colorado	80073	0	0.02	0.98	0	45734	0	0.03	0.96	0.01
09	CT/MA/RI	1929	0	0	1.00	0	1086	0	0	1.00	0
10	DE/NJ	5159	0	0	1.00	0	2905	0	0	1.00	0
12	Florida	7617	0	0	1.00	0	4289	0	0	1.00	0
13	Georgia	16455	0	0	1.00	0	9265	0	0	1.00	0
16	Idaho	12310	0	0.24	0.76	0	8242	0	0.36	0.64	0
17	Illinois	59698	0.10	0	0.89	0.01	34358	0.12	0	0.87	0.01
18	Indiana	31771	0.11	0	0.87	0.02	18332	0.13	0	0.86	0.01
19A	Iowa	195	0	0	1.00	0	110	0	0	1.00	0
19B	Iowa	20725	0	0	0.99	0.01	11666	0	0	0.99	0.01
20	Kansas	29787	0	0.37	0.63	0	21644	0	0.52	0.48	0
21A	Kentucky	42976	0.54	0	0.45	0.01	27318	0.59	0	0.41	0.01
21B	Kentucky	23748	0.98	0	0	0.02	16458	0.98	0	0	0.02
22	Louisiana	600	0	0	1.00	0	338	0	0	1.00	0
23	ME/VT/NH	462	0	0	1.00	0	260	0	0	1.00	0
24	Maryland	16156	0	0	0.99	0.01	9088	0	0	0.99	0.01
26	Michigan	5435	0	0	1.00	0	3060	0	0	1.00	0
27	MI/WI	34767	0	0	1.00	0	19576	0	0	1.00	0
28	Mississippi	4277	0	0	1.00	0	2380	0	0	1.00	0
29	Missouri	67079	0	0	1.00	0	37733	0	0	0.99	0.01
30A	Montana	30002	0	0.06	0.93	0.01	17707	0	0.10	0.89	0.01
30B	Montana	21788	0	0	1.00	0	12268	0	0	1.00	0
31	Nebraska	153026	0	0.06	0.94	0	90456	0	0.11	0.89	0
32	Nevada	3751	0	0.27	0.73	0	2547	0	0.39	0.61	0
35A	New Mexico	6239	0	0	0.97	0.03	3497	0	0	0.97	0.03
35B	New Mexico	10127	0	0	1.00	0	5702	0	0	1.00	0
36	New York	3417	0	0	1.00	0	1924	0	0	1.00	0
37	NC/SC	18662	0	0	1.00	0	10508	0	0	1.00	0
38	North Dakota	39249	0	0	0.99	0.01	22063	0	0	0.99	0.01
39	Ohio	35964	0.20	0	0.77	0.03	21143	0.24	0	0.74	0.02
40	Oklahoma	11842	0.01	0.87	0.12	0	11162	0.01	0.92	0.07	0
41	OR/WA	2730	0	1.00	0	0	2730	0	0	1.00	0
42	Pennsylvania	56929	0.46	0	0.50	0.04	35423	0.51	0.46	0.02	0
46	South Dakota	15945	0	0.29	0.71	0	10998	0	0.42	0.58	0
47A	Tennessee	4965	0.17	0	0.83	0	2906	0	0.20	0.80	0
47B	Tennessee	29538	0.03	0	0.97	0	16740	0.03	0	0.97	0
48	Texas	91562	0	0.41	0.57	0.02	68474	0	0.55	0.43	0.02
49A	Utah	1925	0	0	1.00	0	1084	0	0	1.00	0
49B	Utah	76	0	0	1.00	0	43	0	0	1.00	0
49C	Utah	11599	0	0.10	0.87	0.03	7033	0	0.17	0.81	0.02
51	Virginia	39625	0	0	1.00	0	22309	0	0	0.99	0.01
54A	West Virginia	12637	0.43	0	0.56	0.01	7821	0.48	0	0.51	0.02
54B	West Virginia	21276	0.25	0	0.72	0.03	12660	0.30	0	0.68	0.02
56A	Wyoming	42083	0	0.23	0.77	0	27846	0	0.34	0.66	0
56B	Wyoming	30039	0	0.08	0.91	0	17989	0	0.14	0.86	0
TOTAL			0.09		0.90	0.01	762765	0.09	0.13	0.77	0.01

(a) Gross ton mileage estimates presented here represent the sum of gross ton mileage for rail, truck and waterway transport plus net ton mileage of slurry pipeline transport.

Source: Reference Number 19.

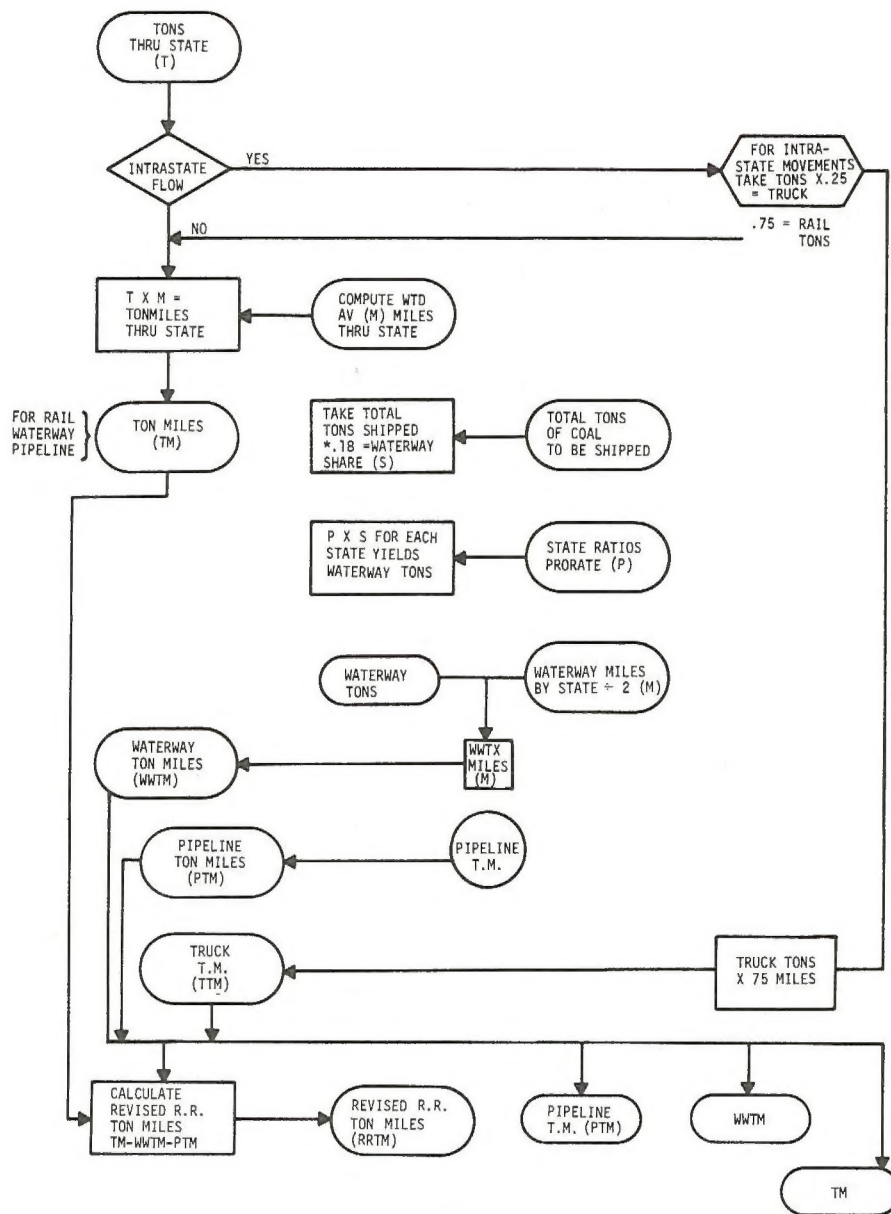


FIGURE H-1
TRANSPORTATION MATRIX-METHODOLOGY (MODAL SPLITS)

TABLE H-11
SUMMARY OF TRANSPORTATION STATISTICS
1985 DOE MID-LEVEL SCENARIO
(All Values Except Miles in 000,000s)

Code/Region	Net Ton Miles				Gross Ton Miles			Tons				Miles			
	Waterway	Pipeline	Railroad	Motor Carrier	Waterway	Railroad	Motor Carrier	Waterway	Pipeline	Railroad	Motor Carrier	Waterway (Round Trip)	Pipeline (One Way Weighted)	Railroad (Weighted Round Trip)	Motor Carrier (Round Trip Average)
01 AL	1,348		20,593	233	1,932	36,573	475	7.168		95	3.107	375		432	150
04 AZ		1,390	8,462	30		15,029	61		5	22	.400		278	758	150
05A AR		2,000	2,926	4		5,197	8		25	33	.050		80	179	150
05B AR		1,250	9,320			16,552			25	59			50	316	
06 CA			4,428			7,864				11				835	
08A CO			3,366	2		5,978	4			84	.030			81	150
08B CO			3			5				(d)				60	
08C CO			503			893				17				58	
08D CO		1,500	44,183	51		78,469	104		15	129	.700		100	685	150
09 CT/MA/RI			1,086			1,929				8				278	
10 DE/NJ			2,905			5,159				29				203	
12 FL			4,289			7,617				16				530	
13 GA			9,265			16,455				67				277	
16 ID		3,000	5,242			9,310			10	17			300	627	
17 IL	4,176		29,762	420	5,984	52,857	857	6.425		165	5.600	1,300		361	150
18 IN	2,466		15,641	225	3,534	27,778	459	12.329		113	3.000	400		277	150
19A IA			110			195				2				100	
19B IA			11,643	23		20,678	47			62	.306			376	150
20 KS		11,150	10,494			18,637			63	39			177	538	
21A KY	16,188		11,083	47	23,197	19,683	96	32.540		95	.627	498		234	150
21B KY ^(a)	16,188		(b)			-	551	32.540		-	3.600	498		-	150
22 LA ^(a)			338	270		600				1				563	
23 ME/VT/NH			260			462				2				260	
24 MD			9,026	62		16,030	126			64	.827			282	150
26 MI			3,060			5,435				35				174	
27 MN/WI			19,576			34,767				55				717	
28 MS			2,380			4,227				29				163	
29 MO			37,733	32		67,014	65			139	.427			544	150
30A MT		1,900	15,698	109		27,880	222		.38	98	1.453		50	322	150
30B MT			12,268			21,788				56				436	
31 NE		9,825	80,631			143,201			63	158			156	1,019	
32 NV		996	1,551			2,755			.12	6			83	495	
35A NM			3,390	107		6,021	218			32	1.426			214	150
35B NM			5,702			10,127				15				750	
36 NY			1,924			3,417				25				155	
37 NC/SC			10,508			18,662				44				481	
38 ND			21,815	248		38,743	506			58	3.307			752	150
39 OH	5,022		15,605	516	7,197	27,714	1,053	19.316		109	6.880	520		286	150
40 OK	81	10,250	829	2	116	1,472	4	.462	63	7	.030	350	163	246	150
41 OR/WA		2,730	(c)			-			10	-			273	-	
42 PA	18,226		16,177	1,020	26,118	28,730	2,081	47.587		77	13.600	765		422	150
46 SD		4,625	6,365	8		11,304	16		25	78	.107		185	163	150
47A TN	572		2,334		820	4,145		1.034		22		553		215	
47B TN	572		16,155	13	820	28,691	27	1.034		114	.173	553		283	150
48 TX		37,800	29,592	1,082		52,555	2,207		53	54	14.427		713	1,094	150
49A UT			1,084			1,925				9				238	
49B UT			43			76				1				108	
49C UT		1,200	5,681	152		10,089	310		12	23	2.027		100	485	150
51 VA			22,294	15		39,594	31			103	.200			433	150
54A WV	3,748		3,953	120	5,371	7,021	245	20.200		42	1.600	186		189	150
54B WV	3,748		8,619	293	5,371	15,307	598	20.200		67	3.910	186		259	150
56A WY		9,500	18,346			32,583			73	111			130	330	
56B WY		2,480	15,453	56		27,445	114		48	64	.747		52	480	150
Total	72,335	101,596	583,694	5,140	103,657	1,036,638	10,487	(e)	(e)	(e)	69	6,184	2,890	19,763	3,900

- (a) Since most of Kentucky's coal moves via waterway, using railroad net ton-miles to estimate waterway ton-miles understated ton-miles since waterway traffic is 26 percent more circuitous than rail. Railroad ton-miles have been increased by 26 percent for Kentucky.
- (b) Assume zero rail ton-miles.
- (c) Assume all pipeline.
- (d) Insignificant value equals 0.1.
- (e) Since tons are unique to a shipment and not a state, tons for rail and barge cannot be added since this would involve double counting. The same ton moves through all states on its route.

Source: Reference Number 19.

case to produce a unique ratio for each alternative. Table H-12 presents the calculated ratios for each alternative.

- Base case gross ton-mileage (by mode of transport within each consuming region) was then multiplied by the ratio to obtain revised estimates of gross ton-mileage for each program alternative.

H.3 COAL IMPACT ESTIMATION PROGRAM.

In order to identify and evaluate nationwide coal cycle impacts, on a quantitative basis for a range of alternative Federal coal management programs, a computerized analytical tool, the Coal Impact Estimation Program (CIEP) has been developed. The CIEP consists of the following major modules:

- Main Impact Estimation Module.
- Socioeconomic Impact Estimation Module
- Ecological Impact Estimation Module

H.3.1 Main Impact Estimation Module.

The five major classes of input information required to operate the Main Impact Estimation Module are:

- Production levels
- Transportation levels
- Consumption levels
- Coal cycle flow distribution
- Environmental loading factors

Coal production, transportation, and consumption estimates for each region of the country are inputted to the routine to produce numerical estimates of the major environmental residuals. This is done by expressing coal production, transportation and consumption levels as flows through the coal cycle. Once quantities of coal flowing into each phase of the coal cycle are calculated (based on percent distribution) for each geographic area, the environmental loading factors are then applied.

H.3.1.1 Production Levels. Production input flows in 100,000 ton units of coal are first divided between surface and underground mining by the application of percent distribution levels. Then the resulting quantities are multiplied by a loading factor to generate residuals from mining operations. Also, the production input flows are divided between crushing and screening and mechanical cleaning by the application of percent distribution levels. The resulting quantities are then multiplied by a loading factor to generate residuals from coal cleaning operations. These residuals are added to generate total residuals resulting from production input flows or are stored to be added to residuals generated from the other phases of the coal cycle (see Figure H-2).

H.3.1.2 Transportation Levels. Transportation input flows in billion gross ton-miles of coal transported are first divided among rail, barge, truck, and slurry pipeline modes by the application of percent distribution levels. Then the resulting quantities are multiplied by a loading factor to generate residuals from transportation activities. These residuals are added to generate total residuals resulting from transportation input flows or are stored to be added to residuals generated from the other phases of the coal cycle.

H.3.1.3 Consumption Levels. Consumption input flows in 100,000 ton units of coal are first divided among steam/electric, synthetic gas, synthetic liquid, and metallurgical use by the application of percent distribution levels. Then the resulting quantities are multiplied by a loading factor to generate residuals from conversion activities. These residuals are added to generate total residuals resulting from conversion input flows or are stored to be added to residuals generated from the other phases of the coal cycle. Similar residuals generated from production, transportation, and consumption activities are then added to generate total residuals resulting from the coal development activity.

H.3.2 Socioeconomic Impact Estimation Subroutine

The socioeconomic impact estimation subroutine uses estimates of direct construction and direct operating workers generated by the main impact estimation routine and applies employment multipliers to generate indirect workers. Then the indirect workers are split into married and single components by means of a percent multiplier. The married component is then multiplied by the family size multiplier to generate married workers and dependents. To that, the single component is added to arrive at workers and dependents associated with direct construction workers (see Figure H-3). Similarly the subroutine processes direct operation workers to generate estimates of indirect workers and dependents.

The four separate worker and dependent components are then summed to arrive at a total worker and dependent population. Total population is then multiplied by rates of services and facilities required per 1,000 population to derive estimates of:

- Public school children.
- Physicians.
- Hospitals.
- Housing units.
- Water treatment (MGD).
- Sewerage treatment (MGD).
- Solid waste generated.
- Policemen.
- Firemen.

Teachers are calculated by applying pupil/teacher ratios to public school children. Then, the services and facilities are multiplied by fiscal multipliers to arrive at fiscal requirements on a regional basis.

H.3.3 Ecological Impact Estimation Subroutine

The ecological impact estimation subroutine uses acreage disturbed throughout the coal cycle, on both a long term and a short term basis, generated in the Main Impact Estimating Routine, and applies percent multipliers to estimate land disturbed by land use category. Density multipliers are used to generate decreases in wildlife. Then land disturbed by category (other than cropland) is multiplied by productivity multipliers to generate estimates of tons of hay, grass, trees, or vegetation lost. Cropland disturbed is multiplied by a percent multiplier to generate estimates of acres disturbed by crop, such as corn, soybeans, cotton, wheat, oats, and sugarbeets. Each of the agricultural product estimates is multiplied by productivity estimates to generate estimates of the losses in

TABLE H-12

RATIOS USED IN TRANSPORTATION^(a)

ALTERNATIVES	1976	1985			1990		
		LOW	MED.	HIGH	LOW	MED.	HIGH
Baseline Year	0.592						
DOE Midlevel			1.0			1.422	
No Leasing		0.875	0.998	1.073	0.094	1.382	1.66
PRLAs Only			0.995			1.38	
Short Term Leasing			0.997			1.375	
Meet Industry Needs			1.035			1.415	
State Determination			1.005			1.362	
Preferred		0.871	0.996	1.093	0.897	1.397	1.745

(a) Ratios based on estimate done for 1985 DOE Mid-level transportation values by R.L. Banks and Associates, Inc. Ratios derived by adding total production and consumption tonnage per year for each alternative and dividing by the same total for 1985 DOE Mid-level Alternative.

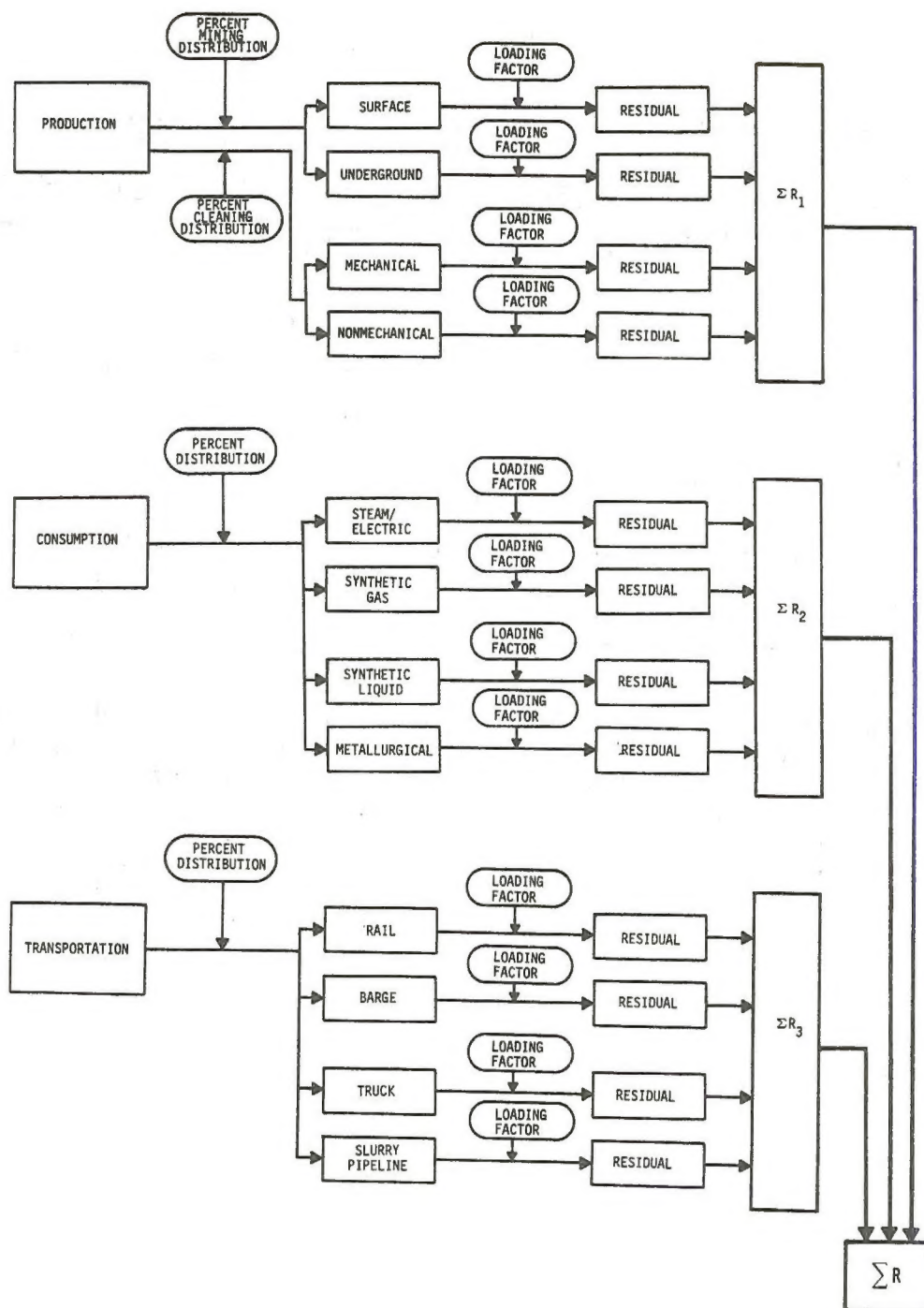


FIGURE H-2
MAIN IMPACT ESTIMATING ROUTINE (RESIDUALS ESTIMATOR)

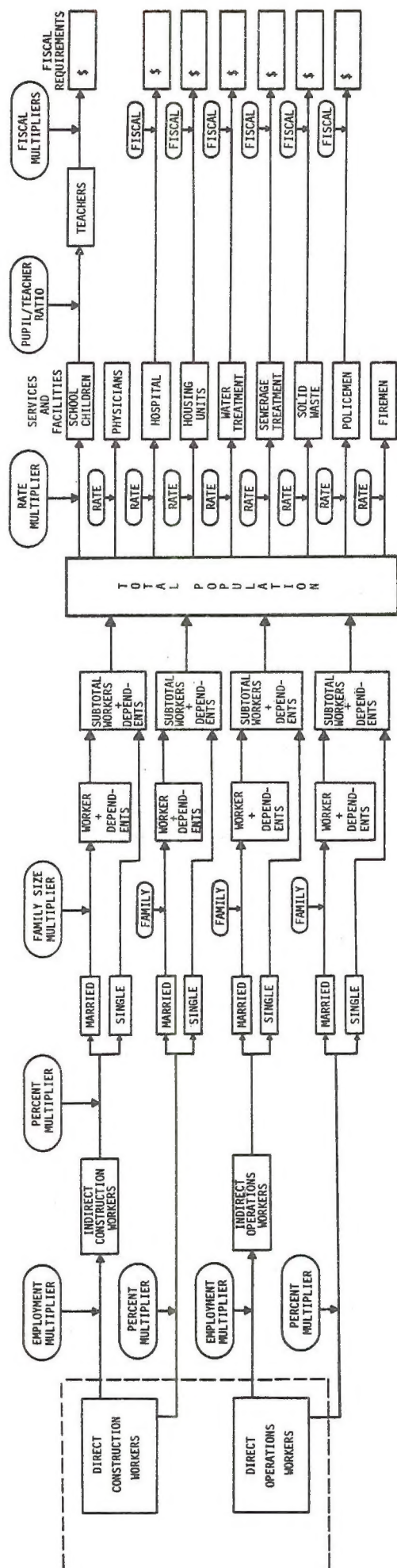


FIGURE H-3
SOCIOECONOMIC ESTIMATING SUBROUTINE

primary productivity such as bushels of corn forgone per acre disturbed (see Figure H-4).

H.4 ENVIRONMENTAL LOADING FACTORS

The methodology described in section 5.1 uses "environmental loading factors" to identify and quantify environmental impact residuals associated with coal extraction, preparation, transportation, and conversion. These loading factors relate specific impacts to 100,000-ton units of coal. This approach was used in all coal cycle phases with the exception of transportation. In the transportation sector, impacts were estimated on the frequency of occurrence per billion gross ton-miles travelled. By expressing all impacts in terms of tons of coal, estimation of impact residuals can be readily accomplished once a coal production level is determined.

Tables H-37 to H-89 present the environmental loading factors which were applied to flows of coal in the particular geographic units assessed in this ES. In states where no coal production occurred, (e.g. Florida) the production coal flows equaled zero. The transportation and conversion flows were positive, thus resulting in positive impacts when the appropriate loading factor was applied. The following examples illustrate how the environmental, socioeconomic, and ecologic residuals were derived.

Environmental loading factors used as input to the main Impact Estimation Routine were generated for 17 major categories for the 53 geographic regions defining the United States (41 producing regions, overlain with 53 consuming regions). Additional multipliers were also generated for a broad range of social, economic, and environmental parameters estimated in socioeconomic subroutines. The environmental loading factors are derived from literature and published data. Then the loading factors are multiplied by input data for production, transportation, and conversion two, to produce residuals (e.g. residuals = Flow x Percent x Loading Factor). The following are examples of residuals developed by the main impact estimation routine.

H.4.1 Total Suspended Particulates (TSP)

The loading factor for particulate (TSP) emissions from crushing and screening operations is 24 pounds of particulate per ton coal cleaned without control devices.¹ By assuming 99 percent control efficiency, the loading factor would be 12 tons/100,000 tons. For example:

	1976 ²	1985 ²	1990 ²
Annual coal production in Colorado-Uinta (in 100,000 tons)	21.7	43	77
Percent coal cleaned (crushing and screening)	71.9	71.9	71.9
Loading factors tons/100,000 tons	12	12	12
Annual TSP emitted from crushing and screening in tons	188	371	664

H.4.2 Direct Construction Workers

For surface mine construction workers in Colorado (Uinta), the residuals are calculated:

	1976 ³	1985 ³	1990 ³
Annual coal production × 10 ⁵ tons	21.7	43	77
Percent coal mined by surface methods	0	42	19
Loading factors tons/10 ⁵ tons	3.21	3.21	3.21
Numbers of workers required for surface mining	0	58	47

The loading factor is based on peak employment during construction of a 5.6 million tons per year mine and is estimated to be 180 workers.⁴ Output of the mine divided into number of workers produces estimates of construction workers per 100,000 tons capacity. This would be 180 divided by ((5.6 times 10⁶) divided by 105) which equals 3.21⁴.

H.4.3 Direct Operation Workers

The annualized loading factor for underground mine operators in Colorado (Uinta) is 19.7.⁵ Multiplying this factor by the coal production flow results in the following calculation:

	1985 ⁶
Annual coal production in the Colorado (Uinta) region in 100,000 tons	43
Percent mined underground	58
Loading factor in workers/10 ⁵ tons	19.7
Underground miners in Colorado (Uinta)	491

Applying this same methodology to the direct construction worker loading factor of 4.8 yields 120 underground direct construction workers for this region. These operation and construction worker numbers provide the basis for calculating total population by using the Socioeconomic Impact Estimation Subroutine. Specifically, assuming 1.4 indirect workers per direct worker, a 75 percent married workforce, and a 2.5 average family size,⁷ the following estimates are made.

¹Derived from U.S. Environmental Protection Agency, [7].

²DOE needs alternative, medium production level.

³DOE mid-level.

⁴Toman *et al.*, 1976.[25]

⁵Derived from U.S. ERDA [8]

⁷Derived from U.S. ERDA [7]

Underground Workers	Workers and Dependents	
Direct operation	491	1,043 ⁸
Direct construction	120	255
Indirect operation	687	1,467
Indirect construction	168	<u>357</u>
Total	3,116	

This results in a population of 3,116 related to underground mining in the Colorado-Uinta Region for the 1985 DOE mid-level production. When these assumptions and methodologies are applied to all phases of the coal cycle, the total population in the region related to coal production amounts to 7,058.

Remaining socioeconomic characteristics are estimated per 1,000 population units. For example:

Total population	-	7,058
Policemen required per 1,000 population	-	2.1
Total policemen required	-	15

Similar calculations are shown in Table H-13 for other socioeconomic variables. It should be noted that numbers tabulated in other sections of this report may vary slightly from this example since they are related to production level changes between 1976-1985 and 1985-1990.

H.4.4 Acreage Disturbed

Since specific locations for the various activities required for coal development were unknown, a land-use forecast was developed for each region and used as a tool to display potential impacts to the natural environment.

Loading factors (multipliers) for land disturbed to produce 100,000 tons of coal were developed as a function of acreage, coal seam thickness and average yield per acre - foot.

In the Colorado-Uinta region, average coal seam thickness is 11 feet, and average yield is 1,750 tons per acre-foot of seam. This yields a multiplier of 5.2 acres for each 100,000 tons of coal required. In 1985, 94 acres would be disturbed per 100,000 tons of coal. This is obtained as follows:

Annual coal production in the Colorado-Uinta region in 1000,000 tons	43
Percent surface mined	42
Loading factor	<u>5.2</u>
Land disturbed short-term (acres)	94

When these assumptions and methodologies are applied to all phases of the coal cycle the total land disturbed (short-term) would be 156 acres.

These acreage disturbed residuals provide the basis for calculating the potential losses of plant and animal productivity by using the Ecological Impact Estimation Subroutine.

Once the total number of acres for each time period was determined, a percentage was allocated to various land uses as presented in Table H-14. The assumption was made that

¹⁰Acres of land disturbed in 1985 were multiplied by ten to give a "worst-case" estimate of land disturbance from 1976-1985 based on the assumption that an equal amount of land would be committed each year. Similarly, acres disturbed in 1990 were multiplied by five to give a total number of acres disturbed between 1986-1990.

development would occur in currently undeveloped or open areas, and not in urban or built-up areas.

Acres by land-use category were multiplied by productivity estimates (Table H-15) to determine potential losses due to land disturbance. Potential losses to wildlife due to habitat loss were determined by multiplying total acres disturbed for each time period by estimated population densities. (See Tables H-16 and H-17).

As an illustration, 8,446 acres were estimated to be required for coal development in the Powder River Region under the medium production level of the preferred alternative in 1985. Of this total 455 acres (5 percent) were allocated to cropland, 91 acres (1 percent) to pasture, 7463 acres (88 percent) to range, 73 acres (1 percent) to forest, and 364 acres (4 percent) to wetland or bottomland forest (see Table H-14). However, these numbers were analyzed outside the subroutine to allow for the entire time period under consideration.¹⁰

Following this initial allocation, cropland was further divided into acres by crop, based on major crops grown in the states occurring in the Region (see Table H-18) as follows:

Wheat	287 acres (63 percent)
Hay	150 acres (33 percent)
Oats	9.1 acres (2 percent)
Sugarbeets	4.6 acres (1 percent)

By multiplying acres by average yields per acre for the respective crops, (Table H-15), an estimate of the potential agricultural production loss can be determined.

Crop	Acres	Average Yield	Potential Loss
Wheat	287	26.2 bu/acre	7,520 bushels
Hay	241 ¹¹	1.7 tons/acre	255 tons
Oats	9.1	43.0 bu/acre	391 bushels
Sugarbeets	4.6	19.5 tons/acre	90 tons

Similarly, by multiplying acres allocated to range and forest (upland and bottomland) by rate of potential production (Table H-15), productivity losses for natural ecosystems can be determined. (See Table H-19.)

Potential loss of wildlife due to habitat loss was estimated by the subroutine by multiplying typical population densities (Tables H-16 and H-17) by the total number of acres disturbed. (See Table H-20.)

The above potential losses in natural and agricultural productivities and wildlife reflect the short-term effects due to total land conversion during 1985. To determine potential losses from 1976-1985, the above were multiplied by ten. Actual losses would be determined by site-specific characteristics, and the acres actually subjected to the direct and indirect effects associated by specific activities.

¹¹Acres of pasture were assumed to be equal to hay in productivity; 241 acres reflects total of 150 acres allocated to hay production plus 91 acres allocated to pasture.

TABLE H-13

SOCIOECONOMIC CHARACTERISTICS

SOCIOECONOMIC VARIABLES	ESTIMATED NUMBER
<u>Socio-economic Variables</u>	<u>Estimated Number</u>
Public School Children	1,553
Teachers	83
Physicians	7
Hospital Beds	35
Housing Units	2,350
Water Treatment (mgd)	1
Sewage Treatment (mgd)	1
Solid Waste (tpd)	18
Firemen	14

TABLE H-14

PERCENTAGE OF THE TOTAL LAND DISTURBED ALLOCATED TO VARIOUS LAND-USE CATEGORIES WITHIN EACH REGION

Coal Region	Cropland (%)	Pasture (%)	Range (%)	Forest (%)	Wetland (%)
Northern Appalachian	32	9.5	-	57	1
Central Appalachian	21	18.0	-	60	1
Southern Appalachian	28	14	-	55	2
Eastern Interior	68	11	-	15	5
Western Interior	52	11	15	17	5
Texas	22	8	34	28	8
Powder River	5	1	88	1	4
Green River-Hams Fork	4	1	70	24	1
Fort Union	37	2	54	2	5
San Juan River	2	1	50	45	1
Uinta-Southwestern Utah	3	1	62	33	1
Denver-Raton Mesa	21	1	56	21	-

TABLE H-15

ESTIMATED PRODUCTIVITY PER ACRE FOR NATURAL AND AGRICULTURAL CROP

Coal Region	Upland Forest (tons/acre)	Wetland/ Bottomland Forest (tons/acre)	Range (tons/acre)	Pasture ^(a) (tons/acre)	Corn ^(b) (bu/acre)	Soybeans ^(b) (bu/acre)	Cotton ^(b) (lbs/acre)	Wheat ^(b) (bu/acre)	Sugarbeets ^(b) (tons/acre)	Oats ^(h) (tons/acre)
Northern Appalachian	8.9	17.8	--	1.9	79.9	26.8	--	38.5	--	48.3
Central Appalachian	8.9	17.8	--	1.9	79.9	26.8	--	38.5	--	48.3
Southern Appalachian	8.9	17.8	--	1.9	79.9	26.8	380	38.5	--	48.3
Eastern Interior	8.9	17.8	--	1.9	100.7	32.5	--	38.6	--	--
Western Interior	8.9	17.8	5.8	2.0	84.6	25.6	390	29.1	--	--
Texas	7.1	5.4	5.8	2.3	--	--	353	23.3	--	--
Powder River	8.0	5.4	6.7	1.7	--	--	--	26.2	19.5	43.0
Green River-Hams Fork	5.4	5.4	2.0	2.2	95.8	--	--	23.2	18.4	42.0
Fort Union	6.9	5.4	6.7	1.4	--	17.3	--	24.6	19.3	42.1
San Juan River	8.0	5.4	3.2	3.6	96.6	--	720	35.8	17.8	--
Uinta-Southwestern Utah	6.9	5.4	1.8	2.5	95.8	--	--	23.3	17.8	--
Denver-Raton Mesa	8.0	--	7.6	2.9	100.8	--	380	23.4	18.6	--

(a) Hay production

(b) Based on the acreage crop yields for the states occurring in each region.

Sources: Reference Numbers 37, 38, 39 and 40.

TABLE H-16

ESTIMATED DENSITIES OF WILDLIFE PER ACRE IN THE VARIOUS REGIONS

Coal Region	Game Birds	Small Mammals	Birds	Amphibians/ Reptiles	Large Predators
Northern Appalachian	0.25	10	3.5	2.5	0.002
Central Appalachian	0.25	10	3.5	2.5	0.002
Southern Appalachian	0.25	10	3.5	2.5	0.002
Eastern Interior	0.20	10	3.5	2.5	0.002
Western Interior	0.20	10	3.5	2.5	0.002
Texas	0.20	10	3.5	3.5	0.002
Powder River	0.03	9	1.0	2.5	0.002
Green River-Hams Fork	0.16	55	2.5	4.5	0.002
Fort Union	0.14	9	1.0	2.5	0.002
San Juan River	0.20	5	2.5	2.6	0.003
Uinta-Southwestern Utah	0.20	5	2.5	2.6	0.002
Denver-Raton Mesa	0.20	9	2.5	2.6	0.002

SOURCES: Reference Numbers 39, 41, 42, 43 and 44.

TABLE H-17

ACRES REQUIRED TO SUPPORT ONE LARGE GAME MAMMAL OR ONE ANIMAL UNIT

Coal Region	White- tailed Deer	Mule Deer	Pronghorn Antelope	Moose	Elk	Animal Units
Northern Appalachian	14	-	-	-	-	2.19
Central Appalachian	14	-	-	-	-	2.19
Southern Appalachian	14	-	-	-	-	2.19
Eastern Interior	166	-	-	-	-	1.7
Western Interior	33	-	-	-	-	2.6
Texas	17	-	-	-	-	6.6
Powder River	33	200	166	-	-	15.5
Green River-Hams Fork	-	125	66	250	125	9.3
Fort Union	33	200	125	-	-	8.2
San Juan River	-	333	-	-	-	11.04
Uinta-Southwestern Utah	-	100	-	-	100	8.3
Denver-Raton Mesa	-	100	100	-	-	16.3

SOURCES: Reference Numbers 39, 41, 42, 43 and 44.

TABLE H-18

PERCENTAGE OF CROPLAND ACRES ALLOCATED TO THE VARIOUS CROPS WITHIN EACH REGION

Coal Region	Corn	Soybeans	Cotton	Wheat	Oats	Sugarbeets	Hay
Northern Appalachian	35	23	-	10	2	-	28
Central Appalachian	24	33	-	3	-	-	40
Southern Appalachian	19	48	6	-	-	-	27
Eastern Interior	50	36	-	9	-	-	4
Western Interior	27	25	2	29	-	-	16
Texas	-	31	29	23	-	-	15
Powder River	-	-	-	63	2	1	33
Green River-Hams Fork	9	-	-	43	1	2	44
Fort Union	-	-	-	60	11	-	27
San Juan River	10	-	5	47	-	2	35
Uinta-Southwestern Utah	11	-	-	49	-	2	36
Denver-Raton Mesa	13	-	1	53	-	2	31

TABLE H-19

PRODUCTIVITY LOSSES FOR NATURAL ECOSYSTEMS

<u>Vegetation</u>	<u>Acres</u>	<u>Rate of Production</u>	<u>Potential Loss</u>
Range	7,463	6.7 Tons/Acre	50,000 Tons
Upland Forest	73	8.0 Tons/Acre	600 Tons
Bottomland (Forest-Wetland)	364	5.4 Tons/Acre	1,970 Tons

TABLE H-20

POTENTIAL LOSS OF WILDLIFE DUE TO HABITAT LOSS

<u>Population</u>	<u>Estimated Density</u>	<u>Acres</u>	<u>Total Individuals Lost</u>
Small Mammals	9 Individuals/Acre	8,446	76,000
Song Birds	1 Individual/Acre	8,446	8,400
Game Birds	0.03 Individual/Acre	8,446	250
Predators	0.002 Individual/Acre	8,446	17
Amphibians/Reptiles	2.5 Individual/Acre	8,446	2,100
Large Game			
Mule Deer	0.005 Individual/Acre	8,446	42
Antelope	0.006 Individual/Acre	8,446	50
White-Tailed Deer	0.03 Individual/Acre	8,446	253

H.5 DERIVATION OF ENVIRONMENTAL LOADING FACTORS

H.5.1 AIR EMISSIONS

H.5.1.1 Recovery and Extraction. The air emissions from mining 100,000 tons of coal per day were calculated as below.

Air emissions from surface mining operations are generated from the use of diesel equipment. Emissions from underground mining operations are assumed to be negligible because of the wide use of electrical equipment. Table H-21 shows the air loading factors for the regions that were derived from U.S. Research, and Development Administration. [8]

H.5.1.2 Coal Cleaning (Beneficiation).

Coal cleaning is the process by which undesirable materials are removed from bituminous and anthracite coal and lignite. The coal is screened, classified, washed, and dried at coal preparation plants. The major sources of air pollution from these plants are the thermal dryers. The average particulate emissions are: 24 lb/ton of coal cleaned without control, and by assuming 99 percent control efficiency, particulate emissions would be 12 tons/100,000 tons of coal crushed and screened. For mechanically cleaned coals, the emission factor would be 18 tons/100,000 tons of coal cleaned. [7]

H.5.1.3 Transportation. The loading factors for coal transportation systems are based on gross ton-miles transported (which incorporates the coal weight plus weight of equipment, as well as the weight of equipment that returns empty). The next step in the methodology is to calculate total gross ton-miles on a state-by-state basis. This is accomplished through calculation of route lengths for origin/destination flows of coal. Total ton-miles per state were expressed on the basis of 10^9 gross ton-miles. Multipliers were then calculated in terms of impacts generated per billion (10^9) ton-miles.

Because of their wide-spread use, transportation facilities are responsible for a large share of air pollutant emissions in many areas of the United States. Typical unit train emissions have been estimated at 18.5, 6.5, and 4.7 pounds of nitrogen oxides, carbon monoxide, and hydrocarbon respectively, per train mile of travel [7].

Similarly, emissions from tugs, trucks, and locomotives (short haul) are based on emission factors derived from U.S. Environmental Protection Agency, [8]. These factors are listed in Table H-22. These numbers are converted into pounds per gross tons-miles transported.

H.5.1.4 Steam-Electric Power Plants. Coal is burned in a wide variety of furnaces to produce heat and steam. Coal-fired furnaces range in size from small, hand-fired units with capacities of 10 to 20 pounds of coal per day to large, pulverized coal-fired units which may burn 300 to 400 tons of coal per hour. Based on emission factors listed in Table H-23, the loading factors are found in Table H-24.

Steam-electric power plants are assumed to emit pollutants at a rate equivalent to the New Source Performance Standards (NSPS). This assumption is conservative, since NSPS are subject to revision and would presumably be made stricter as control technologies improve. Furthermore, the assumption that facilities emit at NSPS discounts the

possibility that many plants may emit at a rate lower than regulations require, especially because of better coal characteristics. Therefore, estimates of the cumulative air impacts should be on the high side.

The emission factors for sulfur oxides and particulate for different geographic units are estimated based on coal characteristics listed in Table H-25.

H.5.1.5 Gasification and Liquefaction Processes. The two important sources of air emissions from coal conversion and combustion plants include:

- Process operations, and
- Auxiliary operations (operations that result in burning fuel).

Process operations occur in enclosed and pressurized systems and emissions from pump seals, joints and flanges, among others. The amount of such emissions would depend upon maintenance operations carried on the systems, safety-controls installed to prevent leakage (and collection system installed, as well as, treatment of vent-gases). Since commercial-scale plants have not yet been built in the United States, the information regarding the composition and the amount of some emissions is not readily available in the published data. However, it is assumed that under normal operations some emissions from process operations would not be significant as compared to emissions from auxiliary operations. Therefore, for the purpose of this report, only the auxiliary operations are considered in estimating air emissions associated with coal conversion plants. Unit plants for each of the technologies considered in this report have been defined by the U.S. Energy Research and Development Administration [7].

To determine the emissions from auxiliary operations, it is assumed that all auxiliary power is generated by the burning of coal (or another fuel equivalent). The amount of coal that would be consumed for auxiliary operations by individual unit plants depends upon the type of coal and its Btu content. The amount of coal to be used for auxiliary operations is a fixed portion of coal consumption by the unit plant. Coal consumption by the auxiliary operations is estimated to be:

- Gasification process: 18 percent of total coal consumption (average of Hygas and CO_2 acceptor processes),
- Liquefaction process: 11.2 percent of total coal consumption, (based on H-coal direct hydrogeneration processes).

For gasification, an average input feed rate of 16,846 tons of coal per day and 28,454 tons of coal per day for a of Hygas and day and 28,454 tons per day for a Hygas and CO_2 Acceptor process yielded the following emissions estimates:

Pollutants	Tons of Emissions per	
	22640 tons	100,000 tons
HC	15	66.3
CO	3	13.3
SO_2	5.3	23.4
NO_x	17	75.0
TSP	1.2	5.3

Similarly the emissions for liquefaction were based on the H-Coal process (See Table H-26).

TABLE H-21
AIR EMISSIONS FROM SURFACE MINING^(a)
(pounds)

EMISSION	COAL REGION											
	Northern Appala- chian	Central Appala- chian	Southern Appala- chian	Eastern Inter- ior	Western Inter- ior	Texas	San Juan River w/ Black Mesa	Uinta- S.W. Utah	Green River- Hams Fork	Powder River	Fort Union	Denver Raton Mesa
SOx	600	600	600	900	900	300	500	600	600	600	600	600
NOx	7,800	9,100	9,100	12,500	12,500	4,300	7,200	7,700	7,700	7,700	7,700	7,700
Particulates	300	300	300	1,000	1,000	1,200	900	800	800	800	800	800
CO	4,700	5,600	5,600	7,600	7,600	2,900	4,400	4,400	4,700	4,700	4,700	4,700
Hydrocarbons	800	800	800	1,400	1,400	400	800	800	900	900	900	900

(a) All loadings per 100,000 tons of coal mined

Source: Reference Number 8.

TABLE H-22

AIR EMISSIONS FROM MODES OF TRANSPORTATION
(lbs/miles)

EMISSION	LONG-HAUL RAIL (DIESEL)	FEEDER RAIL	TRUCK	TUG
SO _x	2.85 ^(a)	0.57	0.0062	0.0029
NO _x	18.5	3.7	0.04	0.03
CO	6.5	1.3	0.063	0.011
HC	4.7	0.94	0.01	0.0054
TSP	1.25 ^(a)	0.25	0.0029	0.00011

Long-haul Rail - unit trains of 100 cars - 10,000 ton capacity.

Feeder Rail - 20 cars of 100 tons coal capacity each - 2,000 ton capacity. 0.1 miles/gallon was assumed.

Truck - 20 tons capacity highway trucks. 150 tons capacity short haul.

Tug - Barges - As many as 36 barges of 1,500 tons capacity each - 54,000 tons per trip and 9 miles/gallon used.

(a) Was assumed five times Feeder Rail (five locomotives vs. one).

SOURCES: Reference Numbers 7 and 45.

TABLE H-23

EMISSION FACTORS FOR BITUMINOUS COAL COMBUSTION
WITHOUT CONTROL EQUIPMENT

Furnace Size, 10 ⁶ BTU/hr. Heat Input (a)	Particulates (b)		Sulfur Oxides (c)		Carbon Monoxide		Hydrocarbons (d)		Nitrogen Oxides	
	lb/Ton Coal Burned	kg/MT Coal Burned	lb/Ton Coal Burned	kg/MT Coal Burned	lb/Ton Coal Burned	kg/MT Coal Burned	lb/Ton Coal Burned	kg/MT Coal Burned	lb/Ton Coal Burned	kg/MT Coal Burned
Greater than 100 (Utility and Large Industrial Boilers)										
Pulverized										
General	16A	8A	38S ^(c)	19S	1	0.5	0.3	0.15	18	9
Wet Bottom	13A ^(e)	6.5A	38S	19S	1	0.5	0.3	0.15	30	15
Dry Bottom	17A	8.5A	38S	19S	1	0.5	0.3	0.15	18	9
Cyclone	2A	1A	38S	19S	1	0.5	0.3	0.15	55	27.5
10 to 100 (Large Commercial and General Industrial Boilers)										
Spreader Stoker ^(f)	13A ^(g)	6.5A	38S	19S	2	1	1	0.5	15	7.5
Less Than 10 (Commercial and Domestic Furnaces)										
Spreader Stoker	2A	1A	38S	19S	10	5	3	1.5	6	3
Hand-Fired Units	20	10	38S	19S	90	45	20	10	3	1.5

(a) 1 Btu/hr = 0.252 kcal/hr.

(b) The letter A on all units other than hand-fired equipment indicates that the weight percentage of ash in the coal should be multiplied by the value given. Example: If the factor is 15 and the ash content is 10 percent, the particulate emissions before the control equipment would be 10 times 15, or 160 pounds of particulate per tons of coal (10 times 8, or 80 kg of particulates per MT of coal).

(c) S equals the sulfur content (see footnote b above).

(d) Expressed as methane.

(e) Without fly-ash reinjection.

(f) For all other stokers use 5A for particulate emission factor.

(g) Without fly-ash reinjection. With fly-ash reinjection use 20A. This value is not an emission factor but represents loading reaching the control equipment.

SOURCE: Reference Number 7.

TABLE H-24

AIR EMISSIONS FROM COAL COMBUSTION

EMISSION	LBS/TONS OF COAL (NO CONTROLS) ^(a) (Tons/100,000 tons)		CALCULATED TONS/100,000 TONS ^(b) OF COAL FIRED (WITH CONTROLS)	
HC	0.3	(15)	15	
CO	1.0	(50)	50	
SO _x	38S	(1900S)	95S	
NO _x	18	(900)	450	
TSP	16A	(800A)	8A	

(a) The letter A on all units other than hand-fired equipment indicates that the weight percentage of ash in the coal should be multiplied by the value given. Example: If the factor is 15 and the ash content is 10 percent, the particulate emissions before the control equipment would be 10 times 15, or 160 pounds of particulate per tons of coal (10 times 8, or 80 kg of particulates per MT of coal). S equals the sulfur content.

(b) Assumes 95 percent SO_x control, 99 percent TSP control, 50 percent NO_x control, and 0 percent CO and HC control.

Source: Reference Number 7.

TABLE H-25

COAL CHARACTERISTICS BY REGION

CHARACTERISTIC	NORTHERN APPALACHIAN	CENTRAL APPALACHIAN	SOUTHERN APPALACHIAN	EASTERN INTERIOR	WESTERN INTERIOR	TEXAS	SAN JUAN RIVER (including Black Mesa Field)		UINTA- S.W. UTAH	GREEN RIVER- HAMS FORK	POWDER RIVER	FORT UNION	DENVER-RATON MESA	
% Surface Mining ^(a)	43	40	37	75	75	100	63		0	100	100	100	20	
Ash Sulfur ratio (%) by weight ^(b)	10:1.7	8:2.2	9:1.1	11:2.8	13:4.2	9:0.8	San Juan River	Black ^(c) Mesa Field	8:1.0	5:0.6	9:0.5	7:0.4	Denver 6:0.3	Raton Mesa 13:0.5
Geographic Units	PA OH WV (A) MD	WV (B) VA KY (A) TN (A)	TN (B) GA AL	IA (A) IL IN KY (B)	IA (B) MO, KS AR (A) OK, NE	TX AR (B) LA	NW (A) CO (B) UT (B)	AZ CO (C) UT (C)	CO (C) UT (C)	CO (A) WY (B) ID UT (A)	MT (A) WY (A)	MT (B) ND SD	CO (D)	CO (D) NM (B)

(a) Source: Reference Number 46.

(b) Source: Reference Numbers 15, 47, and 48.

(c) Arizona State is not included in the San Juan River Region.

TABLE H-26

AIR EMISSIONS FROM COAL LIQUEFACTION PLANTS

AIR POLLUTANTS	EMISSION LEVELS	
	Tons/20,773 Tons of Coal ^(a)	Tons/100,000 Tons of Coal
HC	-	10.7
CO	1.8	8.7
SO _x	18	68.7
NO _x	10.5	50.4
TSP	0.2	1.0

(a) Coal Feed: 20,773 Tons per Day.

Source: Reference Number 8.

H.5.1.6 Metallurgical Coal. Two processes are used for the manufacture of metallurgical coke, the beehive process and the by-product process. The by-product process accounts for more than 98 percent of the coke produced [8]. Emissions are based on Table H-27 and Table H-28.

H.5.1.7 Delivery. Air emissions in this phase of the coal fuel cycle result from heavy duty, gaseous fueled internal combustion engines which are used in the oil and gas industry for driving compressors in pipeline pressure boosting systems, and in gas distribution. Loading factors for gas lines were derived from publications of the U.S. Environmental Protection Agency [8] and the U.S. Energy Research and Development Administration [7]. The following factors per 100,000 tons of coal equivalent are obtained:

HC: 0.663 tons
CO: Negligible
SO_x: 0.3315 tons
NO_x: 0.5525 tons
TSP: Negligible

There are no air emissions from the distribution and transmission of electricity or from electrically driven pumps that operate gas or liquid pipelines.

H.5.2 Water Use

Water is a major resource required in coal development. It is required in (1) mining operations and revegetation, (2) coal preparation, (3) transportation, and (4) conversion processes. The largest water consumption is the evaporation of water used in cooling and in pollution control. On a per unit Btu basis, more water is evaporated for cooling electric power generation than in synfuel processes [9].

H.5.2.1 Recovery and Extraction. The principal categories that consume water in coal mining are dust control for roads, mines, and embankments and revegetation of reclaimed areas. However, the mine location and the type of mine, surface or underground, would strongly influence the quantity of water consumed.

Water sprayed for dust control in the mine and on the road are based rainfall and evaporation rates and are calculated based on area disturbed, evaporation rate, rainfall rate, and wetted area rate.

Using the above relationship, and based upon the evaporation rates of

- (1) 45 inch/year for Fort Union region;
- (2) 54 inch/year for Green River region;
- (3) 61 inch/year for San Juan region; and
- (4) 49 inch/year for Powder River region;

The water requirements would be:

	lb. of water/lb of coal mined (surface)	acre ft/100,000 tons
Fort Union	0.055	4.047
GR/Denver	0.038	2.796
SJ/Uinta	0.052	3.827
Powder River	0.047	3.459
East Central	0.03	2.208

Add to the above 0.0306 lb. water per lb. of coal for revegetation the loading factor for surface mining results. Also assume 75 percent of water used for revegetation and 100 percent of the water used for dust control is evaporative. Therefore, the effluent loading factor for surface mining is (0.25 multiplied by 2.252) or 0.56 acre ft. per 100,000 tons. This methodology results in the following loading factors of the extraction phase of the coal cycle (See Table H-29).

H.5.2.2 Coal Cleaning (Beneficiation). In coal preparation plants, dust is generated during loading and unloading, breaking, conveying, crushing and general screening, and storage. Water is used to control fugitive dust, and to wash the coal to lower the ash and sulfur content. Jigging is used in over half of all coal-washing facilities. The water loading factor for crushing and screening is 1 lb. of water/50 lb. of coal or 1.5 acre ft 100,000 [10]. For mechanically cleaned coal most of wet washing is done by the jigging process (63 percent for the year 1975). The amount of water needed is 270 gpm per 696 TPH cleaned, or 7.12 acre-ft/100,000 tons cleaned which is divided as follows: 3.12 acre-ft/100,000 tons evaporative, 4.0 acre-ft/100,000 tons effluent.

H.5.2.3 Transportation. The transportation of coal via slurry pipeline consists of the use of finely powdered coal mixed with water. By assuming 50 percent by weight water use, then 100,000 tons of coal would require 50,000 tons or 36.8 acre-ft, of water.

H.5.2.4 Steam Electric. The amount of coal consumed by 3,000 MWe power plant is 8,154,255 tons/year, and the annual water requirements for the plant are 28,000 acre-ft/year [9]. Thus water required per 100,000 tons of coal is 343 acre-ft. Of the 343 acre-ft, 90 percent is evaporative or 309 acre-ft and the remaining 34 acre-ft are effluent.

H.5.2.5 Synthetic Gas and Liquid. Loading factors were derived from a publication of the U.S. Energy Research and Development Administration [7]. The water make up per 100,000 tons coal gasified is 179 acre-ft and the effluent portion of that is 46 acre-ft. The water make up per 100,000 tons of coal liquified is 147 acre-ft, and the effluent portion of that is 43 acre-ft.

H.5.2.6 Coke Plant. The water use in the by-product process for the manufacturing of coke is mostly for quenching coke, and for cooling purposes. Cooling water use is 107 gal/ton coke and quench water use is 350 gal/ton coke of which 123 gallons are evaporative and 227 gallons are effluent. Therefore total water makeup is: 107 + 350 = 457 gal/ton coke of which 123 gal/ton evaporate and 334 gal/ton are effluent [11]. Convert the above to acre-ft/100,000 tons of coal, and assume 70 percent conversion from coal to coke [12].

TABLE H-27

EMISSION FACTORS FROM METALLURGICAL COKE MANUFACTURE
WITH CONTROLS (a)

Type of operation	Particulates		Sulfur ^(c) dioxide		Carbon monoxide		Hydrocarbons ^(b)		Nitrogen oxides (NO ₂)		Ammonia	
	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT
By-product coking												
Unloading	0.4	0.2	-	-	-	-	-	-	-	-	-	-
Charging	1.5	0.75	0.02	0.01	0.6	0.3	2.5	1.25	0.03	0.015	0.02	0.01
Coking cycle	0.1	0.05	-	-	0.6	0.3	1.5	0.75	0.01	0.005	0.06	0.03
Discharging	0.6	0.3	-	-	0.07	0.035	0.2	0.1	-	-	0.1	0.05
Quenching	0.9	0.45	-	-	-	-	-	-	-	-	-	-
Underfiring	-	-	4	2	-	-	-	-	-	-	-	-
Beehive ovens	200	100	-	-	1	0.5	8	4	-	-	2	1

- (a) Emission factors expressed as units per unit weight of coal charged.
- (b) Expressed as methane.
- (c) The sulfur dioxide factor is based on the following representative conditions: (1) sulfur content of coal charged to oven is 0.8 percent by weight; (2) about 33 percent by weight of total sulfur in the coal charged to oven is transferred to the coke-oven gas; (3) about 40 percent of coke-oven gas is burned during the underfiring operation and the remainder is used in other parts of the steel operation where the rest of the sulfur dioxide is discharged - about 6 lb/ton (3 kg/MT) of coal charged; and (4) gas used in underfiring has not been desulfurized.

Source: Reference Number 7.

TABLE H-28

AIR EMISSIONS FOR COKE PRODUCTION

<u>Emissions</u>	<u>Lbs/Tons of Coal</u>	<u>Tons/100,000 Tons of Coal Burned</u>	
		<u>Without Control</u>	<u>With Control</u>
HC	4.2	210	210
CO	1.27	63.5	63.5
SO ₂	4.02	202.5	10.1
NO _x	0.04	2	1.0
TSP	3.5	175	1.8

Source: Derived from Reference Number 7.

TABLE H-29

WATER LOADING FACTORS FOR EXTRACTION PHASE OF COAL CYCLE

COAL REGION	SURFACE EFFLUENT	SURFACE (a)	U.G. (b)	U.G. EFFLUENT (c)
Fort Union	0.56	6.299	3.68	1.84
Green River-Hams Fork Denver-Raton Mesa	0.56	5.048	3.68	1.84
San Juan River/ Uinta-Southwestern Utah	0.56	6.079	3.68	1.84
Powder River	0.56	5.711	3.68	1.84
Other Regions	0.56	4.460	5.88 (d)	2.94

Water requirement for miners is included in the socioeconomic section.

- (a) Water required for dust control and revegetation.
 (b) For underground mining 50 lb./1,000 lb. coal or 3.68 acre/ft./100,000 tons of coal.
 (c) Assume 50 percent of water used is effluent.
 (d) Source: Reference Number 50.

The loading factors are:

- Make up water: 457 gal/ton coke or 200.3 acre-ft/100,000 tons of coal
- Effluent water: 123 gal/ton coke or 53.9 acre-ft/100,000 tons of coal, and
- Evaporative water: 334 gal/ton coke or 146.4 acre-ft/100,000 tons of coal

H.5.2.7 Delivery. There are no water uses in this phase of the coal fuel cycle.

H.5.3 Acreage Disturbed

H.5.3.1 Surface mining. The number of acres required to produce 100,000 tons of coal is based on average coal seam thickness and average yield per acre-foot of seam. The calculations for Colorado-Uinta region are: 100,000 tons of coal divided by (11 feet seam thickness times 1,750 tons per acre foot) which equals 5.2 acres.

Regional variations in average coal seam thickness produces different loading factors that are shown on individual factor sheets. Acres disturbed by underground mining operations are negligible.

H.5.3.2 Coal Cleaning (Beneficiation). A loading factor for land required for coal cleaning was derived from a 1,000 ton per hour (24,000 ton/day) plant sited on 75 acres of land [49]. This loading factor is 0.85 acres per 100,000 tons coal cleaned.

H.5.3.3 Rail Transportation. A loading factor for rail transport of 32.4 acres/mile was derived from an average railroad right-of-way width of 268 feet [7].

H.5.3.4 Truck Transportation.

A loading factor for land required for truck traffic was derived from average right of way width in a typical roadway network [7]. An average right-of-way width of 75 feet would take 9.1 acres of land per mile of roadway.

H.5.3.5 Coal Slurry Pipeline. One pipeline (48 inch diameter) could require up to 13 acres of land per mile while 2 pipelines sharing a common right of way could require up to 15 acres per mile [7]. Additional land would be required for support facilities such as pumping stations and coal slurry dumping basins. For a coal slurry pipeline, each pump station, including dump basin and water reservoir would require about 40 acres per 100 miles of line [13].

H.5.3.6 Steam Electric. A loading factor for a steam electric generating plant was derived based on the assumption that 500 acres of land is required by a plant which burns 10,000 tons a day [7]. This loading factor is 13.6 acres per 100,000 tons of coal mined.

H.5.3.7 Synthetic Gas. A loading factor for a synthetic gas plant was derived based on the assumption that 900 acres of land are required by a plant that consumes 22,640 tons of coal per day [7]. This loading factor is 10.9 acres per 100,000 tons of coal mined.

H.5.3.8 Synthetic Liquid. A loading factor for a synthetic liquid plant was derived based on the assumption that 475

acres of land would be required by a plant that consumed 20,773 tons of coal per day [7]. This loading factor is 6.3 acres per 100,000 tons of coal mined.

H.5.3.9 Coke plants. A loading factor for a metallurgical (coking) plant was derived based on the assumption that 60 acres of land would be required by a plant that consumed 10,000 tons of coal each day [14]. This loading factor is 1.89 acres per 100,000 tons of coal mined.

H.5.3.10 Transmission lines. A loading factor of 18.2 acres per mile was derived for a transmission line based on an average right-of-way of 150 feet [7].

H.5.3.11 Liquid and Gas Pipelines. A loading factor for pipelines of 15 acres per mile was derived based on an average right-of-way width of 125 feet [7].

H.5.4 Solid Wastes

H.5.4.1 Recovery and Extraction. For underground mining, the amount of inactive wastes generated is approximately 3 percent of the coal extracted [15].

For surface mining, solid wastes generated are returned to mining pits. Active wastes are not removed until the coal cleaning phase.

H.5.4.2 Coal Cleaning (Beneficiation). Data used to estimate the amount of solid waste generated during crushing and screening and mechanical cleaning were provided in [12] and [15]. The amount of solid waste generated by crushing and screening assumed to be equally proportional to the mechanical cleaning waste data.¹² Also, national mechanical cleaning data shows that the ratio of solid waste to clean coal is 40 percent [12]. Therefore, where no data are available for mechanically cleaned coal, the 40 percent ratio was used.

Data tabulated in Table H-30 were taken from the two sources listed above or derived according to the previously mentioned assumption.

Waste values are multiplied by 1,000 to yield tons of solid waste per 100,000 tons of coal mined. For example, the loading factors for Alabama (Southern Appalachian Coal Region) are 15,972 and 19,775 ton per 100,000 tons of coal for crushing and screening, and mechanically cleaned coal, respectively.

H.5.4.3 Transportation. No solid waste is generated during transportation activity.

H.5.4.4 Conversion. The quantity of inert and active wastes generated during coal conversion is related to the ash and sulfur content of the coal. Ash sulfur ratios were determined in Table H-31 [7] [16].

H.5.4.5 Steam/Electric Plants. Inert (ash) and active (sludge) solid wastes are produced at a rate of 10,429 and 11,756 tons per 100,000 tons of coal converted when using 12 percent ash and 3 percent sulfur content coal [17]. Assuming a directly proportional relationship between ash, sulfur content and solid waste generation, the following quantities of inert and

¹²The amount of solid waste from mechanical cleaning divided by coal cleaned mechanically equals the solid waste from crushing and screening divided by coal crushed and screened.

TABLE H-30
COAL CLEANING DATA

(1,000 tons)

	Col.1 Total Coal Produced (Mined)	Col.2 Mechanically Cleaned Coal	Col.3 Solid Waste	Col.4 Non-Mech. Cleaned Coal	Col.5 Solid Waste	Col.6 Non- cleaned Coal	Col.3 Col.1 Waste From Mech.Cleaning (% of Total Coal Produced)	Col.5 Col.1 Waste From Non-Mech. Cleaning (% of Total Coal Produced)
ALABAMA	35,144	11,228	6,950	8,966	5,550	2,450	19.775	15.792
ARIZONA	9,780	0	0	6,986	2,794	0	0	28.568
ARKANSAS	664	211	84	230	92	47	12.650	13.855
COLORADO	11,400	2,043	817	5,911	2,364	265	7.167	20.737
GEORGIA	97	0	0	57	23	17	0	23.711
ILLINOIS	78,679	45,120	14,872	12,957	4,270	1,460	18.902	5.427
INDIANA	32,271	19,402	5,585	5,425	1,562	297	17.306	4.804
IOWA	859	0	0	593	237	29	0	27.590
KANSAS	667	471	188	0	0	8	28.186	0
KENTUCKY:								
Eastern	116,978	23,764	9,369	51,626	20,353	11,866	8.009	17.399
Western	69,908	19,814	5,938	25,404	7,613	11,139	8.494	10.890
MARYLAND	3,430	137	55	1,923	769	546	1.603	22.420
MISSOURI	7,192	1,478	591	2,407	963	1,753	8.217	13.390
MONTANA	30,871	0	0	22,044	8,818	9	0	28.564
NEW MEXICO	12,279	1,016	406	7,769	3,108	0	3.301	25.270
NORTH DAKOTA	11,090	0	0	6,437	2,575	2,078	0	23.219
OHIO	68,634	14,108	7,742	25,732	14,121	6,931	11.210	20.574
OKLAHOMA	3,968	601	240	2,139	856	32	6.048	21.572
PENNSYLVANIA	113,973	42,572	17,600	29,595	12,235	11,971	15.442	10.735
TENNESSEE	10,964	1,642	657	5,253	2,101	1,311	5.992	19.163
TEXAS	15,296	0	0	10,734	4,294	268	0	28.073
UTAH	9,738	3,444	1,378	3,498	1,399	19	14.151	14.366
VIRGINIA	48,064	12,875	5,150	18,511	7,404	4,124	10.715	15.404
WASHINGTON	5,237	3,735	1,494	0	0	8	28.528	0
WEST VIRGINIA	150,790	63,139	25,256	40,628	16,251	5,516	16.749	10.777
WYOMING	32,574	124	50	21,799	8,720	1,881	0.153	26.770

Source: Reference Numbers 11 and 14.

TABLE H-31

ASH : SULFUR RATIOS

<u>Coal Region</u>	<u>Ash : Sulfur Ratios</u> <u>By Weight Percent</u>
Northern Appalachian	10 : 1.7
Central Appalachian	8 : 2.2
Southern Appalachian	9 : 1.1
Eastern Interior	11 : 2.8
Western Interior	13 : 4.2
Texas	9 : 0.8
Powder River	9 : 0.5
Fort Union	7 : 0.4
Green River-Hams Fork	5 : 0.6
San Juan River	9 : 0.8
Black Mesa Field	15 : 0.9
Uinta-Southwestern Utah	8 : 1.0
Denver	6 : 0.3
Raton Mesa	13 : 0.5

Source: Reference Numbers 15 and 8.

active wastes would be produced per 100,000 tons of coal mined (see Table H-32).

For example, the loading factor for Alabama (Southern Appalachia) is 7,822 tons of inert waste per 100,000 tons of coal burned.

H.5.4.6 High Btu Gasification. Coals with an ash : sulfur ratio of 10.8 percent to 3.9 percent are known to yield 2,155 tons of inert solid waste (ash) and negligible active waste per 16,846 tons of coal processed [7]. Assuming a directly proportional relationship between ash content and solid waste generation, the following quantities of inert wastes would be produced per 100,000 tons of coal mined. (See Table H-33.)

H.5.4.7 Low Btu Gasification. Coals with an ash to sulfur content of 7.2 percent to 0.6 percent are known to yield inert (ash) and active (dolomite and sulfur compounds) solid wastes at a rate of 2,583 and 1,860 tons, respectively, per 28,434 tons of coal processed [7]. Assuming a directly proportional relationship between ash and sulfur content and solid waste generation, the following quantities of inert and active wastes would be produced per 100,000 tons of coal processed (See Table H-34).

High and low Btu values were averaged to obtain gasification loading factors (See Table H-35).

For example, the loading factor for Alabama (Southern Appalachian) is 10,432 tons of inert waste for 100,000 tons of coal (10,064 + 10,800 divided by 2).

H.5.4.8 Synthetic Liquid. Coals with an ash to sulfur ratio of 9.12 percent to 4.45 percent are known to yield 2,015 tons of inert solid waste (slag, soot) per 20,773 tons of coal processed [7].

Active wastes (dolomite, sulfur compounds) are generated at a rate of 1,860 tons per 20,773 tons of processed coal. Assuming a direct proportional relationship between ash:sulfur content and solid waste generation, the following quantities of inert and active wastes would be produced per 100,000 tons of coal mined. (see Table H-36).

For example, the loading factor for Alabama is 9572 tons of inert waste per 100,000 tons of coal liquefied [2,015 times 100,000 times 9 divided by (20773 times 9.12)].

H.5.4.9 Coke Plant. During coke making, 200 acre-feet of water are normally required per 100,000 tons of coal processed [11]. Of this, about 146.4 acre-feet become effluent. The average concentration of suspended sediments in effluent is approximately 1 percent solids. Therefore, tons of solid are calculated to be 1,985 tons.

H.5.4.10 Delivery. No solid wastes would be generated during delivery phase of the coal cycle.

H.5.5 Fatalities

H.5.5.1 Recovery and Extraction. The surface mining fatality rate is 0.011 fatalities per 100,000 tons mined; the deep mining fatality rate is 0.04 per 100,000 tons mined. These loading factors were derived from Table 39 in Injury Experience in Coal Mining 1975, Mining Enforcement and Safety Administration [18].

H.5.5.2 Coal Cleaning (Beneficiation). Loading factors were based on the following assumptions:

- 1975 total coal processed = 374.1×10^6 tons (raw coal).
- 1975 total man hours worked = 29.130×10^6 hours.
- Averaged processed coal per man hour = 12.84 tons/man-hour.
- Average man-hours necessary to process 100,000 tons (raw coal) = 100,000 divided by 12.84 = 7787 man hours.
- Average fatality rate (coal cleaning plants) = 0.31 fatalities per 10^6 man hours or 0.031 fatalities per 100,000 man hours.
- National average fatalities per 100,000 tons of raw coal processed = (7786 divided by 10^5) \times 0.031 = 0.0002.
- For crushing and screening plants fatality rates are assumed to be 1/3 those for mechanical plants, or 0.00005.

H.5.5.3 Transportation. Loading factors were based on the following assumptions:

- 0.2135 fatalities per 10 billion gross ton-miles traveled by unit trains.
- 47.2 fatalities per 10 billion gross ton-miles traveled by trucks.

These factors were estimated on the methodology set out by Bliss [19] and data supplied by Banks [20].

H.5.5.4 Conversion. The steam electric power plant fatality rate was derived from fatality data presented by Bliss [19] and equals 0.00006 fatalities per 100,000 tons of coal.

Fatality rates for gasification and liquefaction plants are 0.0017 fatalities per 100,000 tons used in gasification plants, and 0.0011 fatalities per 100,000 tons used in liquefaction plants [7].

H.5.5.5 Coke Plants. Coke oven fatalities are estimated to equal 0.001 per 10^5 tons feed. Derived from standards promulgated by the U.S. Department of Labor [21, 22].

H.5.6 Operating Energy

The operating energy consumed in the coal fuel cycle includes:

H.5.6.1 Recovery and Extraction. The overall operating energy required for coal extraction is 4 percent of the Btu content of marketable coal [23, 24].

Based on 22 million Btus per ton of coal, the loading factor for coal extraction is 0.088 trillion Btus/100,000 tons of coal [$0.04(22 \times 10^6 \times 10^5)$].

H.5.6.2 Refining and Processing (Beneficiation). The operating energy required for crushing and screening coal is 0.7 percent, and for mechanically cleaned and dried coal is 4.6 percent of the Btu content of coal [23, 25]. Therefore, the loading factor for coal crushing and screening is 0.0154 trillion Btus/100,000 tons of coal [$0.007(22 \times 10^6 \times 10^5)$], and for mechanical cleaning is 0.1 trillion Btus/100,000 tons of coal [$0.046(22 \times 10^6 \times 10^5)$].

H.5.6.3 Coal Transport. The operating energy required in the transportation sector is measured in Btus consumed per ton-mile transported and is a function of the mode of transportation as follows [32]:

TABLE H-32

INERT AND ACTIVE WASTES PRODUCED BY STEAM/ELECTRIC PLANTS

<u>Coal Region</u>	<u>Solid Waste (tons)</u>	
	<u>Inert</u>	<u>Active</u>
Northern Appalachian	8,691	6,662
Central Appalachian	6,953	8,621
Southern Appalachian	7,822	4,310
Eastern Interior	9,560	10,972
Western Interior	11,298	16,458
Texas	7,822	3,135
Powder River	7,822	3,135
Fort Union	13,036	3,527
Green River-Hams Fork	6,953	3,919
San Juan River	4,345	2,351
Black Mesa Field	7,822	1,959
Uinta-Southwestern Utah	6,084	1,567
Denver	5,214	1,176
Raton Mesa	11,298	1,959

Source: Reference Numbers 8 and 15.

TABLE H-33

PROJECTED INERT SOLID WASTE PER HIGH BTU GASIFICATION PLANT

COAL REGION	INERT SOLID WASTE (tons)
Northern Appalachian	11,183
Central Appalachian	8,946
Southern Appalachian	10,064
Eastern Interior	12,301
Western Interior	14,537
Texas	10,064
Powder River	10,064
Fort Union	7,828
Green River-Hams Fork	5,591
San Juan River	10,064
Black Mesa Field	16,774
Uinta-Southwestern Utah	8,946
Denver	6,710
Raton Mesa	14,537

Source: Reference Numbers 8 and 15.

TABLE H-34

PROJECTED INERT AND ACTIVE WASTE PER LOW BTU GASIFICATION PLANT

<u>Coal Region</u>	<u>Inert Solid Waste (tons)</u>	<u>Active Solid Waste (tons)</u>
Northern Appalachian	12,001	1,279
Central Appalachian	9,601	1,656
Southern Appalachian	10,800	828
Eastern Interior	13,200	2,108
Western Interior	15,601	3,161
Texas	10,800	602
Powder River	10,800	376
Fort Union	8,401	300
Green River-Hams Fork	6,000	452
San Juan River	10,800	602
Black Mesa Field	18,002	677
Uinta-Southwestern Utah	9,601	752
Denver	7,201	225
Raton Mesa	15,601	377

Source: Reference Numbers 8 and 15.

TABLE H-35

AVERAGE INERT AND ACTIVE WASTES PER GASIFICATION PLANT

<u>Coal Region</u>	Inert	Active
	<u>Solid Waste (tons)</u>	<u>Solid Waste (tons)</u>
Northern Appalachian	11,592	1,279
Central Appalachian	9,274	1,656
Southern Appalachian	10,432	828
Eastern Interior	12,750	2,108
Western Interior	15,069	3,161
Texas	10,432	602
Powder River	10,432	376
Fort Union	8,114	300
Green River-Hams Fork	5,796	452
San Juan River	10,432	602
Black Mesa Field	17,388	677
Uinta-Southwestern Utah	9,274	752
Denver	6,956	225
Raton Mesa	15,069	377

Source: Reference Numbers 8 and 15.

TABLE H-36

INERT AND ACTIVE WASTE FOR SYNTHETIC LIQUEFACTION PLANTS

<u>Coal Region</u>	<u>Inert Solid Waste (tons)</u>	<u>Active Solid Waste (tons)</u>
Northern Appalachian	10,636	3,420
Central Appalachian	8,509	4,427
Southern Appalachian	9,572	2,213
Eastern Interior	11,700	5,634
Western Interior	13,827	8,451
Texas	9,562	1,610
Powder River	9,572	1,006
Fort Union	7,445	805
Green River-Hams Fork	5,318	1,207
San Juan River	9,572	1,610
Black Mesa Field	15,954	1,811
Uinta-Southwestern Utah	8,509	2,012
Denver	6,381	604
Raton Mesa	13,827	1,006

Source: Reference Numbers 8 and 15.

- 670 Btus/ton-mile for rail transport or 0.670 trillion Btus/Billion ton-mile;
- 680 Btus/ton-mile for barge transport or 0.680 trillion Btus/billion ton-mile;
- 2800 Btus/ton-mile for truck transport or 2.8 trillion Btus/billion ton-miles, and
- 450 Btus/ton-mile for slurry pipe line, or 0.450 trillion Btus/billion ton-miles.

To account for empty return trips of transportation equipment, it is necessary to adjust the above numbers to Btus consumed per gross ton-mile transported. Thus the loading factors are [20]:

- 0.67 divided by 1.78 or 0.3764 trillion Btus/billion ton-miles for rail transport;
- 0.68 divided by 1.43 or 0.4755 trillion Btus/billion ton-miles for barge transport;
- 2.8 divided by 2.04 or 1.3725 trillion Btus/billion ton-miles for truck transport, and
- 0.45 divided by 1.0 or 0.45 trillion Btus/billion ton-miles for slurry pipe lines.

H.5.6.4 Coal Conversion and Utilization. The operating energy measured in Btu input to coal conversion facilities is: 3 percent for steam/electric power plants [24], 2.1 percent for gasification plants, 0.9 percent for liquefaction plants [7], and 2.7 percent for coke plants [11]. Based on 22 million Btus per ton of coal, the loading factors are:

- $[.03(22 \text{ times } 10^6 \text{ times } 10^5)]$ or 0.066 trillion Btus/100,000 tons of coal for steam/electric power plants;
- $[0.021(22 \text{ times } 10^6 \text{ times } 10^5)]$ or 0.046 trillion Btus/100,000 tons of coal for gasification plants;
- $[0.009(22 \times 10^6 \times 10^5)]$ or 0.019 trillion Btus/100,000 tons of coal for liquefaction plants, and
- $[0.027(22 \times 10^6 \times 10^5)]$ or 0.06 trillion Btus/100,000 tons of coal for coke plants.

H.5.6.5 Delivery. Losses in transmission and distribution facilities occur between the electric generating plant busbar and the appliance or piece of equipment which operates on electricity. These losses are approximately 9 percent of the total electricity transmitted. However, substation and transformers use only 1 percent of the electric load transmitted [6]. Therefore, the loading factor is 0.022 trillion Btus/100,000 tons of coal. To operate liquid pipelines to and from refineries, 2.3 percent of the equivalent heat content of oil is consumed; and to operate gas pipelines, 2.9 percent of the equivalent heat content of gas is consumed [23]. Therefore, the loading factors are: 0.0506 trillion Btus per 100,000 tons of coal equivalent for oil lines, and 0.0638 trillion Btus per 100,000 tons of coal equivalent for gaslines.

H.5.7 Operation and Construction Employment

H.5.7.1 Recovery and Extraction. The loading factor is based on peak employment during construction of a 5.6 million tons per year mine and is estimated to be 180 workers. Thus, 3.21 construction workers would be required per 100,000 tons annual output.

Approximately 50 percent more workers are required for underground mine construction, i.e., 4.8 construction workers per 100,000 ton annual output.

Loading factors for direct operation workers are:

- **Underground Miners** — Loading factors for underground miners are derived by utilizing the number of miners required to mine 100,000 tons of coal per day [7] divided by 365 days per year. These numbers vary according to mine characteristics and therefore yield different loading factors for each of the coal regions. In Alabama, the loading factor is 37.8.
- **Surface Miners** — The same methodology was applied utilizing the number of surface miners required to mine 100,000 tons of coal per day divided by 365 varying by region [7]. In Alabama, the loading factor is 17.8.

H.5.7.2 Refining and Processing. During the construction of a coal preparation plant, the peak construction force is 150 men.

In 1975, there were 388 mechanical cleaning plants. They cleaned a total of 374.1×10^6 tons (raw) coal. Average yearly tonnage cleaned per plant equals $964,180 = 9.64$ in 100,000 ton coal units [23, 27]. 150 man-years peak construction effort divided by $9.64 = 15.6$ man years of construction effort per 100,000 ton unit of coal. For crushing and screening plants, assume 1/2 the work force spread over 2 years. For example, a 75 man peak labor force divided by $9.64 = 7.8$ man-years construction effort per 100,000 ton unit of coal crushed and screened [28].

Total man-hours worked in (1975) for a coal preparation plant are based on:

29.13097×10^6 hours [29] Total tonnage cleaned = 374.1×10^6 tons. Therefore, 7,812 man hours are required per 100,000 tons coal cleaned, or 12.84 tons/man hours.

Assuming an 8-hour shift and a 365 day work year, 1 man year = 2,920 man-hours, therefore, 2.67 man years of effort are required to clean a 100,000 ton unit of coal [29, 30].

For crushing and screening plants, operational workers are estimated to be one third of those for mechanical cleaning plants or 0.9 man-years per 100,000 ton unit of coal.

H.5.7.3 Transportation. Loading factors for direct construction workers are:

- **Rail** — Construction workers were derived from a U.S. Energy Research and Development publication [7] and equal 300 construction workers per 1,000 miles of track.
- **Truck** — Highway construction workers were derived from the same publication [7] and equal 170 workers per 1,000 mile system with 3 years to build.
- **Slurry Pipeline** — Pipeline construction workers were derived from [13] and equal 4,900 workers per 1,036 miles of pipeline.

Loading factors for direct operation workers are:

- **Rail** — Rail operator loading factors assume a unit train of 10,000 ton capacity traveling 1,000 miles round trip. Also, a six day turn around time results in approximately 60 trips per year and 110 total operating employees per one million train miles. These assumptions yield 22 employees per billion gross ton-miles.
- **Truck** — This factor assumes a 25 ton capacity truck unit traveling 150 miles round trip and 3 trips per day requiring 1.35 employees per unit or 1,346.4 employees per billion gross ton-miles [31].

- Barge — Barge loading factors assume 21,000 ton capacity (14 barges) per 500 mile round trip and 24 employees per 3.5 day round trip or 44 employees per billion gross ton-miles [31].
- Slurry Pipeline — This factor assumes a capacity of 25 billion ton miles per year and 239 employees or 10 employees per billion net ton-miles [13].

H.5.7.4 Steam Electric. Loading factors for steam electric construction workers are based on the assumption of a 1,000 MWe coal fired power plant which consumes 10,000 tons of coal per day [32]. Also, the peak construction work force amounts to 1,400 workers [33]. Using a 100,000 ton unit of coal results in a loading factor of 38.4 workers per 100,000 tons of coal consumed.

H.5.7.5 Synthetic Gas. Synthetic gas loading factors are derived from data of two gasification plants, one consuming 16,846 tons of coal per day and the other consuming 28,434 tons per day. It also assumes a 1,500 man peak construction work force [7]. These assumptions yield 18.1 workers per 100,000 tons of coal consumed.

H.5.7.6 Synthetic Liquid. This factor assumes a liquification plant which consumes 20,773 tons of coal per day with a peak construction force of 1,500 workers [7]. This yields an estimate of 19.73 workers per 100,000 tons of coal consumed.

H.5.7.7 Coke Plants. The peak labor force for coke oven construction is 180 men [28]. Loading factors are based on:

- Average number of plants under construction = 9 million tons of coke capacity/year.
- 9 million tons of coke = 12,857,000 tons of coal.
- 1975 average number of plants = 62.
- 1975 production (coke) equaled 56,494,000 tons.
- Therefore, average coke production per plant equals 911,193 tons.
- Therefore, to produce 9 million tons, an average of 10 plants is required.
- Total peak construction labor required for 10 plants equals 10 times 180.
- Total construction labor expended = 1,800 divided by 128.57 equals 14.0 man years per 100,000 ton-units. [23, 28, 34].

H.5.7.8 Steam Electric. Loading factors for steam electric operation workers are based a 1,000 MWe coal-fired power plant which consumes 10,000 tons of coal per day [32]. The operating work force of the plant is 160 employees [33]. These assumptions yield an estimate of 4.38 workers per 100,000 ton coal unit.

H.5.7.9 Synthetic Gas. Synthetic gas loading factors are derived from averaging data of two gasification plants. One consumes 16,846 tons of coal and the other consumes 28,434 tons per day [7]. Based upon an operating force of 1,000, calculations yield 12.1 workers per 100,000 of coal feed.

H.5.7.10 Synthetic Liquid. This factor assumes a liquification plant which consumes 20,773 tons of coal per day with an operating force of 1,000 employees [7]. This yields an estimate of 13.15 workers per 100,000 tons of coal feed.

H.5.7.11 Coke Plants. Assuming a coking efficiency of 70 percent, the average coal used per man hour equals 2.1938

tons. For 100,000 tons of coal, an estimated 45 man hours (100,000 divided by 2.1938 equals 45581.8) would be needed to produce 70,000 tons of coke. This is equivalent to 15.6 full time employees.

Thus, the direct employment multiplier for metallurgical coal (coking) is 15.6 per 100,000 tons of coal used [22].

H.5.7.12 Delivery.

Direct Construction Workers:

- Transmission-line construction workers were estimated to be 300 workers per 100 miles of line [7].
- Pipeline (liquid) construction workers for liquid pipelines were estimated to be 1,150 workers per 1,000 miles of pipeline [7].
- Pipeline (gas) construction workers were estimated to be 1,150 workers per 1,000 miles of pipeline [7].

Direct Operation Workers:

- Transmission Operation workers were estimated to equal 20 workers per 100 miles of line [7].
- Pipeline (liquid) operation workers were estimated to equal 115 workers per 1,000 miles of pipeline [31].
- Pipeline (gas) operation workers were estimated to be 139 workers per 1,000 miles of pipeline [31].

H.6 AGRICULTURAL OPPORTUNITY COST DERIVATION METHODOLOGY

This analysis focuses on estimation of monetary costs of trade-offs made if coal development occurs. It is limited to areas where at least partial market information exists.

The opportunity cost of coal production is equal to foregone outputs that could be obtained from the alternative employment of resources used. These resources include land and other natural resources, labor, and capital. Capital is a highly mobile resource with a national market. With respect to capital, there is very little difference at the margin between returns "with" coal development at a particular location versus "without" coal development. Labor tends to be geographically committed to a far greater degree than capital. Most workers tend to stay in one city or town for long periods of their lives; most usually move only when a substantial change occurs in their lives. Thus, if coal resource development were to decrease employment opportunities significantly, it would be necessary to consider that fact as one of the costs of development. This cost would then be added to other development costs to obtain the total costs of coal development.

When considering the opportunity cost of labor, we are assessing the value of labor resources in alternative productive uses. Labor resources would freely move within coal development areas and workers could freely choose their employment activity. It is likely that, given the high wages paid in the mining industry, opportunity costs for labor will be less than wages in coal mining and related activities. Under these conditions, opportunity costs will be generated by those who could be employed in the coal mining industry but elect not to do so.

Land resources are totally fixed, both in location and amount. The opportunity costs of land resource use are the value of outputs foregone due to coal development. The most substantial opportunity costs occur in agricultural production. Surface mining will result in substantial losses in agricultural

TABLE H-37
ENVIRONMENTAL LOADINGS FROM
ALABAMA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0*	0.4	0*	0*	132*	0.0349*	122.6*	0*	15*	66.3*	10.7*	210*
CO	0*	2.8	0*	0*	182.6*	0.0647*	772.1*	0*	50*	13.3*	8.7*	63.5*
SOx	0*	0.3	0*	0*	80*	0.0187*	76.0*	0*	104.5	23.4*	68.7*	10.1*
NOx	0*	4.55	0*	0*	520*	0.1943*	490.2*	0*	450*	75.0*	50.4*	1.0*
TSP	0*	0.15	12*	18*	35*	0.0007*	35.5*	0*	72	5.3*	1.0*	1.8*
Water Make-up: Acre/ft	5.887	4.46	1.5**	7.12**	0*	0*	0*	(a)	343*	175*	147*	200.3*
Evaporative	2.94	3.9	0.75**	3.12**	0*	0*	0*	(a)	309*	129*	111*	53.9*
Effluent	2.94	0.56**	0.75**	4.00**	0*	0*	0*	(a)	34*	46*	36*	146.4*
Land Disturbed (Short-term) acres	0*	11.4	0.85**	0.85**	(a)	(a)	(a)	(a)	13.7*	10.89*	6.33*	1.88*
Land Disturbed (Long-term) acres	0*	3.6	0.25**	0.25**	(a)	(a)	(a)	(a)	8.2	6.53	2.9	0.56*
By-Product Solid (tons) Wastes (inactive)	3,000**	0*	15,792	19,775	0*	0*	0*	0*	7,822	10,432	9572	1985*
By-Product Solid Wastes (active)	0*	0*	0*	0*	0*	0*	0*	0*	4,310	414	2,213	0*
Accidents	3.12**	0.053**	0.0051**	0.0153**	1.966*	0*	434.4*	0*	0.0023*	0.0665*	0.044*	0.1*
Fatalities	.04**	0.011**	0.00005**	0.0002**	0.2135*	0*	47.2*	0*	0.00006*	0.0017*	0.0011*	0.001*
Operating Energy (trillion Btu)	0.088**	0.088**	.0154**	0.1**	0.3764*	0.4755*	1.3725*	0.45*	0.066*	0.046*	.019*	0.06*
Direct Construction Workers	4.8**	3.21**	7.8**	15.6**	(a)	(a)	(a)	(a)	38.4*	18.1*	19.73*	14.0*
Direct Operation Workers	37.8	17.8	2.67**	0.9**	22*	44*	1346.4*	10*	4.38*	12.1*	13.15*	15.6*

* Repeat for 53 geographical units.

** Repeat for producing geographic units only.

(a) Addressed outside the model.

TABLE H-38
ENVIRONMENTAL LOADINGS FROM
ARIZONA-BLACK MESA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.2	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.25	0	0	80	.0187	76.0	0	85.5	23.4	68.7	10.1
NOx	0	3.6	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.45	12	18	35	.0007	35.5	0	120	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	6.023	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	2.2	.25	.25	(a)	(a)	(a)	(a)	7.9	6.32	2.9	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	28,568	0	0	0	0	0	13,036	17,388	15,954	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3,527	338	1,811	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	22.7	4.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-39
ENVIRONMENTAL LOADINGS FROM
ARKANSAS - WESTERN INTERIOR

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	399	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	.25	.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	13,855	12,650	0	0	0	0	11,298	15,069	13,827	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1,580	8,451	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-40
ENVIRONMENTAL LOADINGS FROM
ARKANSAS - TEXAS

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.2	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	1.45	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.15	0	0	80	.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	2.15	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.6	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.7	0.25	0.25	(a)	(a)	(a)	(a)	5.5	4.36	2.53	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	13,855	12,650	0	0	0	0	7,822	10,432	9,572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3,135	301	1,610	0
Accidents	3.21	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	3.6	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-41
ENVIRONMENTAL LOADINGS FROM
CALIFORNIA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	28.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	48	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	8256	11,102	10,104	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1568	150	805	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-42
ENVIRONMENTAL LOADINGS FROM
COLORADO - GREEN RIVER-HAMS FORK

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	57	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	40	5.3	1.0	1.8
Water Make-up: Acre/ft	0	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	4.48	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.3	0.25	0.25	(a)	(a)	(a)	(a)	5.2	4.14	2.41	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	20,737	7,167	0	0	0	0	4345	5796	5318	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	2351	226	1207	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	25.2	4.1	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-43
ENVIRONMENTAL LOADINGS FROM
COLORADO - SAN JUAN RIVER

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.2	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.25	0	0	80	.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	3.6	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.45	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	5.51	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	2.2	.25	.25	(a)	(a)	(a)	(a)	7.9	6.32	2.9	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	20,737	7,167	0	0	0	0	7822	10,432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3135	301	1610	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	22.7	4.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-44
ENVIRONMENTAL LOADINGS FROM
COLORADO - DENVER-RATON MESA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	28.5	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	48	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	4.48	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	14.3	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.0	.25	.25	(a)	(a)	(a)	(a)	5.5	4.36	2.53	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	20737	7167	0	0	0	0	8256	11012	10104	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1568	150	805	0
Accidents	3.12	.053	.0051	.0513	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.0006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	27.7	5.8	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-45
ENVIRONMENTAL LOADINGS FROM
COLORADO - UINTA-SOUTHWESTERN UTAH

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	95	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	5.51	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	5.2	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.1	.25	.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	20,737	7,167	0	0	0	0	6953	9274	8509	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3919	376	2012	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0065	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.93	14.0
Direct Operation Workers	19.7	6.0	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-46
ENVIRONMENTAL LOADINGS FROM
CONNECTICUT - MASSACHUSETTS - RHODE ISLAND

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	8691	11,592	10,636	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6662	640	3420	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-47
ENVIRONMENTAL LOADINGS FROM
DELAWARE - NEW JERSEY

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	8691	11,592	10,636	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6662	640	3,420	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-48
ENVIRONMENTAL LOADINGS FROM
FLORIDA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	9,560	12,750	11,700	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-49
ENVIRONMENTAL LOADINGS FROM
GEORGIA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	.0187	76.0	0	104.5	23.4	68.7	10.1
NOx	0	4.55	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.15	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	11.4	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	.25	.25	(a)	(a)	(a)	(a)	8.2	6.53	3.8	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	23,711	0	0	0	0	0	7822	10432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	4310	414	2213	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.93	14.0
Direct Operation Workers	37.8	17.8	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-50
ENVIRONMENTAL LOADINGS FROM
IDAHO

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	57	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	40	5.3	1.0	1.8
Water Make-up: Acre/ft	0	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	4.48	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.3	.25	.25	(a)	(a)	(a)	(a)	5.2	4.14	2.47	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	26,770	153	0	0	0	0	4345	5796	5318	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	2351	226	1207	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	25.2	4.1	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-51
ENVIRONMENTAL LOADINGS FROM
ILLINOIS

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.6	.25	.25	(a)	(a)	(a)	(a)	3.2	2.5	1.45	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	5,427	18,902	0	0	0	0	9,560	12,750	11,700	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	19.2	11.2	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-52
ENVIRONMENTAL LOADINGS FROM
INDIANA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.6	.25	.25	(a)	(a)	(a)	(a)	3.2	2.5	1.45	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	4,840	17,306	0	0	0	0	9,560	12,750	11,700	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.4755	1.3725	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	19.2	11.2	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-53
ENVIRONMENTAL LOADINGS FROM
IOWA - EASTERN INTERIOR

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	87.9	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.6	.25	.25	(a)	(a)	(a)	(a)	3.2	2.5	1.45	.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	10,890	8,494	0	0	0	0	9,560	12,750	11,700	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	19.2	11.2	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-54
ENVIRONMENTAL LOADINGS FROM
IOWA - WESTERN INTERIOR

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	399	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	.25	.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	27,590	0	0	0	0	0	11,298	15,069	13,827	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1,580	8,451	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-55
ENVIRONMENTAL LOADINGS FROM
KANSAS

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	399	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	.25	.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	0	28,186	0	0	0	0	11,298	15,069	13,827	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1,580	8,451	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside model.

TABLE H-56
ENVIRONMENTAL LOADINGS FROM
KENTUCKY - CENTRAL APPALACHIAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	209	23.4	68.7	10.1
NOx	0	4.55	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.15	12	18	35	.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	129	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	46	146.4
Land Disturbed (Short-term) acres	0	11.4	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	.25	.25	(a)	(a)	(a)	(a)	6.4	5.12	2.97	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	17,399	8,009	0	0	0	0	6953	9274	8509	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	8621	828	4427	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	24.1	12.3	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-57
ENVIRONMENTAL LOADINGS FROM
KENTUCKY - EASTERN INTERIOR

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.6	.25	.25	(a)	(a)	(a)	(a)	3.2	2.5	1.45	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	10,890	8,494	0	0	0	0	9,560	12,750	11,700	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	19.2	11.2	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-58
ENVIRONMENTAL LOADINGS FROM
LOUISIANA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.2	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	1.45	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.15	0	0	80	.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	2.15	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.6	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.7	.25	.25	(a)	(a)	(a)	(a)	5.5	4.36	2.53	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	28,073	0	0	0	0	0	7822	10,432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3135	301	1610	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	3.6	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-59
ENVIRONMENTAL LOADINGS FROM
MAINE/NEW HAMPSHIRE/VERMONT

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	8691	11,592	10,636	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6662	640	3,420	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-60
ENVIRONMENTAL LOADINGS FROM
MARYLAND

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	3.9	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.15	12	18	35	.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.3	.25	.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	22,420	1,603	0	0	0	0	8691	11,592	10,636	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6662	640	3,420	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	33.4	10.4	2.67a	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-61
ENVIRONMENTAL LOADINGS FROM
MICHIGAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	Q	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	9560	12,750	11,700	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-62
ENVIRONMENTAL LOADINGS FROM
MINNESOTA - WISCONSIN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	266	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	88	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons)												
Wastes (inactive)	0	0	0	0	0	0	0	0	9560	12,750	11,700	1987
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	10,972	1,054	5,634	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-63
ENVIRONMENTAL LOADINGS FROM
MISSISSIPPI

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	57	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	40	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	8.2	6.53	3.8	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	4345	5796	5318	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	2351	226	1207	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-64
ENVIRONMENTAL LOADINGS FROM
MISSOURI

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	399	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	.25	.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	13,390	8,217	0	0	0	0	11,298	15,069	13,827	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1580	8451	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-65
ENVIRONMENTAL LOADINGS FROM
MONTANA - POWDER RIVER

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	47.5	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/Ft	0	5.711	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	5.151	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	2.2	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.6	.25	.25	(a)	(a)	(a)	(a)	5.9	4.68	2.72	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	28,564	0	0	0	0	0	7822	10,432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1959	188	1006	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	4.1	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-66
ENVIRONMENTAL LOADINGS FROM
MONTANA - FORT UNION

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	38	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	56	5.3	1.0	1.8
Water Make-up: Acre/ft	0	6.299	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	5.739	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	4.8	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.5	.25	.25	(a)	(a)	(a)	(a)	3.6	2.83	1.64	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	28,564	0	0	0	0	0	6084	8114	7445	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1567	150	805	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	3.3	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-67
ENVIRONMENTAL LOADINGS FROM
NEBRASKA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.7	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.45	0	0	80	.0187	76.0	0	399	23.4	68.7	10.1
NOx	0	6.25	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.5	12	18	35	.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	.25	.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	21,572	6,048	0	0	0	0	11,298	15,069	13,827	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1,580	8,451	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-68
ENVIRONMENTAL LOADINGS FROM
NEVADA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	47.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons)												
Wastes (inactive)	0	0	0	0	0	0	0	0	7822	10,432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1959	188	1006	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.011
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-69
ENVIRONMENTAL LOADINGS FROM
NEW MEXICO/SAN JUAN RIVER

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.2	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.25	0	0	80	.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	3.6	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.45	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	5.51	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	2.2	.25	.25	(a)	(a)	(a)	(a)	7.9	6.32	3.67	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	25,270	3,301	0	0	0	0	7822	10,432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3135	301	1610	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	22.7	4.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-70
ENVIRONMENTAL LOADINGS FROM
NEW MEXICO/DENVER-RATON MESA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	28.5	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	48	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	4.48	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	14.3	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.0	.25	.25	(a)	(a)	(a)	(a)	5.5	4.36	2.53	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	25,270	3,301	0	0	0	0	8256	11,012	10,104	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1568	150	805	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	27.7	5.8	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-71
ENVIRONMENTAL LOADINGS FROM
NEW YORK

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	8691	11,592	10,636	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6662	640	3,420	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-72
ENVIRONMENTAL LOADINGS FROM
NORTH CAROLINA - SOUTH CAROLINA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	.0187	76.0	0	209	23.4	68.7	10.1
NOx	0	0	0	0	520	.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200.3
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	6953	9274	8509	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	8621	828	4427	0
Accidents	0	0	0	0	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	0	0	0	0	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0	0	0	0	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-73
ENVIRONMENTAL LOADINGS FROM
NORTH DAKOTA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	38	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	56	5.3	1.0	1.8
Water Make-up: Acre/ft	0	6.299	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	5.73	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	4.8	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.5	.25	.25	(a)	(a)	(a)	(a)	3.6	2.83	1.64	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	23,219	0	0	0	0	0	6084	8114	7445	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1567	150	805	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	3.3	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-74
ENVIRONMENTAL LOADINGS FROM
OHIO

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.4	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	3.9	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.15	12	18	35	0.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.3	0.25	0.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	20,574	11,280	0	0	0	0	8,691	11,592	10,636	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6,662	640	3,420	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	33.4	10.4	2.67	0.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-75
ENVIRONMENTAL LOADINGS FROM
OKLAHOMA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal- lurgical
Air Emissions (Tons):												
HC	0	0.7	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	3.8	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.45	0	0	80	0.0187	76.0	0	399	23.4	69.7	10.1
NOx	0	6.25	0	0	520	0.1943	490.0	0	450	75.0	50.4	1.0
TSP	0	0.5	12	18	35	0.0007	35.5	0	104	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	19.0	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.4	0.25	0.25	(a)	(a)	(a)	(a)	5.1	4.05	2.34	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	21,572	6,048	0	0	0	0	11,298	15,069	13,827	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	16,458	1,580	8,451	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	12.3	12.9	2.67a	0.9a	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-76
ENVIRONMENTAL LOADINGS FROM
OREGON - WASHINGTON

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	0	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0	0	0	80	0.0187	76.0	0	47.5	23.4	68.7	10.1
NOx	0	0	0	0	520	0.1943	490.2	0	450	75.0	50.4	1.0
TSP	0	0	0	0	35	0.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	0	0	0	0	0	0	0	(a)	343	175	147	200
Evaporative	0	0	0	0	0	0	0	(a)	309	129	111	53.9
Effluent	0	0	0	0	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0	0	0	(a)	(a)	(a)	(a)	4.1	3.27	1.9	0.56
By-Product Solid (tons) Wastes (inactive)	0	0	0	0	0	0	0	0	7,822	10,432	9,572	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1,959	188	1,006	0
Accidents	0	0	0	0	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0	0	0	0	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0	0	0	0	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	0	0	0	0	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	0	0	0	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-77
ENVIRONMENTAL LOADINGS FROM
PENNSYLVANIA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.4	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	3.9	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.15	12	18	35	0.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.3	0.25	0.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	10,735	15,442	0	0	0	0	8,691	11,592	10,636	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6,662	640	3,420	0
Accidents	3.12	0.53	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	33.4	10.4	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-78
ENVIRONMENTAL LOADINGS FROM
SOUTH DAKOTA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.45	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	38	23.4	68.7	10.1
NOx	0	3.85	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.4	12	18	35	0.0007	35.5	0	56	5.3	1.0	1.8
Water Make-up: Acre/ft	0	6.299	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	5.73	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	4.8	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.5	0.25	0.25	(a)	(a)	(a)	(a)	3.6	2.83	1.64	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	23,219	0	0	0	0	0	6,084	8,114	7,445	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1,567	150	805	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	18.73	14.0
Direct Operation Workers	0	3.3	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-79
TENNESSEE - CENTRAL APPALACHIAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.4	0	0	132	0.0349	112.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	209	23.4	68.7	10.1
NOx	0	4.55	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.15	12	18	35	0.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	0	6.299	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	5.73	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	11.4	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	0.25	0.25	(a)	(a)	(a)	(a)	6.4	5.12	2.97	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	19,163	5,992	0	0	0	0	6,953	9,274	8,509	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	8,621	828	4,427	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.11	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	24.1	12.3	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-80
ENVIRONMENTAL LOADINGS FROM
TENNESSEE - SOUTHERN APPALACHIAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.4	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	104.5	23.4	68.7	10.1
NOx	0	4.55	0	0	520	0.1943	490.3	0	449.6	75.0	50.4	1.0
TSP	0	0.3	12	18	35	0.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	11.4	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	0.25	0.25	(a)	(a)	(a)	(a)	8.2	6.53	3.8	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	19,163	5,992	0	0	0	0	7,822	10,432	9,572	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	4,310	414	2,213	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	37.8	17.8	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-81
ENVIRONMENTAL LOADINGS FROM
TEXAS

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.2	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	1.45	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.15	0	0	80	0.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	2.15	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.6	12	18	35	0.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	2.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.7	0.25	0.25	(a)	(a)	(a)	(a)	5.5	4.36	2.53	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	28,073	0	0	0	0	0	7,822	10,432	9,572	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3,135	301	1,610	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.0	0	0.0023	0.0665	0.044	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	3.6	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-82
ENVIRONMENTAL LOADINGS FROM
UTAH - GREEN RIVER-HAMS FORK

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.45	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	57	23.4	68.7	10.1
NOx	0	3.85	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.4	12	18	35	.0007	35.5	0	40	5.3	1.0	1.8
Water Make-up: Acre/ft	0	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	4.48	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.3	.25	.25	(a)	(a)	(a)	(a)	5.2	4.14	2.4	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	14366	14151	0	0	0	0	4345	5796	5318	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	2351	226	1207	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	.088	.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	25.2	4.1	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-83
ENVIRONMENTAL LOADINGS FROM
UTAH-SAN JUAN RIVER

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.2	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.25	0	0	80	.0187	76.0	0	76	23.4	68.7	10.1
NOx	0	3.6	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.45	12	18	35	.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	5.51	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	1.84	.56	.56	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	2.2	.25	.25	(a)	(a)	(a)	(a)	7.9	6.32	3.67	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	14366	14151	0	0	0	0	7822	10432	9572	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3135	301	1610	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	.3764	.4755	1.3725	.45	.066	.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	22.7	4.9	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-84
ENVIRONMENTAL LOADINGS FROM
UTAH-UINTA-SOUTHWESTERN UTAH

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.45	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	95	23.4	68.7	10.1
NOx	0	3.85	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.4	12	18	35	0.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	3.68	6.079	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	1.84	5.51	.75	3.12	0	0	0	(a)	309	127	111	53.9
Effluent	1.84	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	5.2	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.1	0.25	0.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	14,366	14,151	0	0	0	0	6,953	9,274	8,509	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	3,919	376	2,012	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.0665	0.044	0.1
Fatalities	.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	.3764	0.4755	1.3725	0.45	0.065	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21a	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	19.7	6.0	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-85
ENVIRONMENTAL LOADINGS FROM
VIRGINIA

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	.0647	722.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	209	23.4	68.7	10.1
NOx	0	4.55	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.15	12	18	35	.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	11.4	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	.25	.25	(a)	(a)	(a)	(a)	6.4	5.12	2.97	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	15404	10715	0	0	0	0	6953	9274	8509	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	8621	828	4427	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	.088	.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	24.1	12.3	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-86
ENVIRONMENTAL LOADINGS FROM
WEST VIRGINIA - CENTRAL APPALACHIAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	.4	0	0	132	.0349	122.6	0	15	66.3	10.7	210
CO	0	2.8	0	0	182.6	.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	.3	0	0	80	.0187	76.0	0	209	23.4	68.7	10.1
NOx	0	4.55	0	0	520	.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	.15	12	18	35	.0007	35.5	0	64	5.3	1.0	1.8
Water Make-up: Acre/ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	11.4	.85	.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.6	.25	.25	(a)	(a)	(a)	(a)	6.4	5.12	2.91	.56
By-Product Solid (tons) Wastes (inactive)	3000	0	10777	16749	0	0	0	0	6953	9274	8509	1985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	8621	828	4427	0
Accidents	3.12	.053	.0051	.0153	1.966	0	434.4	0	.0023	.0665	.044	.1
Fatalities	.04	.011	.00005	.0002	.2135	0	47.2	0	.00006	.0017	.0011	.001
Operating Energy (trillion Btu)	.088	.088	.0154	.1	.3764	.4755	1.3725	.45	.066	.046	.019	.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	24.1	12.3	2.67	.9	22	44	1346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-87
ENVIRONMENTAL LOADINGS FROM
WEST VIRGINIA-NORTHERN APPALACHIAN

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.4	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	161.5	23.4	68.7	10.1
NOx	0	3.9	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.15	12	18	35	0.0007	35.5	0	80	5.3	1.0	1.8
Water Make-up: Acre/Ft	5.887	4.46	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	2.94	3.9	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	2.94	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	9.5	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	3.3	0.25	0.25	(a)	(a)	(a)	(a)	6.3	5.01	2.91	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	10,777	16,749	0	0	0	0	8,691	11,592	10,636	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	6,662	640	3,420	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.0	0	0.0023	0.0665	0.44	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	33.4	10.4	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	19.6

(a) Addressed outside the model.

TABLE H-88
ENVIRONMENTAL LOADINGS FROM
WYOMING-GREEN RIVER-HA'S FORK

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.45	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	57	23.4	68.7	10.1
NOx	0	3.85	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.4	12	18	35	0.0007	35.5	0	40	5.3	1.0	1.8
Water Make-up: Acre/ft	0	5.048	1.5	7.12	0	0	0	(a)	343	175	147	200.3
Evaporative	0	4.48	.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	0.56	.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	7.1	0.35	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	1.3	0.25	0.25	(a)	(a)	(a)	(a)	5.2	4.14	2.4	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	26,770	153	0	0	0	0	4,345	5,796	5,318	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	2,351	226	1,207	0
Accidents	3.12	0.053	0.0051	0.0153	1.966	0	434.4	0	0.0023	0.665	0.44	0.1
Fatalities	0.4	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.11	0.001
Operating Energy (trillion Btu)	0.088	0.088	.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	25.2	4.1	2.67	0.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

TABLE H-89
ENVIRONMENTAL LOADINGS FROM
WYOMING-POWDER RIVER

IMPACT	RECOVERY & EXTRACTION (100,000 tons)		REFINING & PROCESSING (100,000 tons)		TRANSPORTATION (billion ton-miles)				CONVERSION (100,000 tons)			
	Underground Mining	Surface Mining	Crushing & Screening	Mechanical	Rail	Rail/Barge	Truck	Slurry Pipeline	Steam (Elect.)	Synthetic Gas	Synthetic Liquid	Metal-lurgical
Air Emissions (Tons):												
HC	0	0.45	0	0	132	0.0349	122.6	0	15	66.3	10.7	210
CO	0	2.35	0	0	182.6	0.0647	772.1	0	50	13.3	8.7	63.5
SOx	0	0.3	0	0	80	0.0187	76.0	0	47.5	23.4	68.7	10.1
NOx	0	3.85	0	0	520	0.1943	490.3	0	450	75.0	50.4	1.0
TSP	0	0.4	12	18	35	0.0007	35.5	0	72	5.3	1.0	1.8
Water Make-up: Acre/ft	0	5.711	1.5	7.12	0	0	0	(a)	343	175	142	200.3
Evaporative	0	5.15	0.75	3.12	0	0	0	(a)	309	129	111	53.9
Effluent	0	0.56	0.75	4.00	0	0	0	(a)	34	46	36	146.4
Land Disturbed (Short-term) acres	0	2.2	0.85	0.85	(a)	(a)	(a)	(a)	13.7	10.89	6.33	1.88
Land Disturbed (Long-term) acres	0	0.6	0.25	0.25	(a)	(a)	(a)	(a)	5.9	4.68	2.72	0.56
By-Product Solid (tons) Wastes (inactive)	3,000	0	26,770	153	0	0	0	0	7,822	10,432	9,572	1,985
By-Product Solid Wastes (active)	0	0	0	0	0	0	0	0	1,959	188	1,006	0
Accidents	3.12	0.053	0.0051	0.153	1.966	0	434.4	0	0.0023	0.0665	0.44	0.1
Fatalities	0.04	0.011	0.00005	0.0002	0.2135	0	47.2	0	0.00006	0.0017	0.0011	0.001
Operating Energy (trillion Btu)	0.088	0.088	0.0154	0.1	0.3764	0.4755	1.3725	0.45	0.066	0.046	0.019	0.06
Direct Construction Workers	4.8	3.21	7.8	15.6	(a)	(a)	(a)	(a)	38.4	18.1	19.73	14.0
Direct Operation Workers	0	4.0	2.67	.9	22	44	1,346.4	10	4.38	12.1	13.15	15.6

(a) Addressed outside the model.

output per acre mined (Table H-90). Values presented in Table H-90 represent the annual gross revenue return per acre to the agricultural sector, by state. Some double counting is inevitable because sales within the farm sector are not netted out.¹³ Double counting results in over estimation of the value of final agricultural products produced. The degree of over estimation is related to the interdependence of a region's agricultural sector with respect to both agriculture itself and also other sectors of the economy (e.g., trade, services, etc.).¹⁴

Although the opportunity cost estimates presented in Table H-90 overstate the time level of such costs, they represent the maximum annual agricultural opportunity cost per acre of land used for production of coal. It is assumed that, in the foreseeable future, rehabilitated land will not yield agricultural output commensurate with pre-mining levels of production. It is anticipated that, for each acre of land required for coal development in each region, the annual opportunity cost approximates the values presented in Table H-90. The estimates presented can be refined in two specific ways.

First, by estimating a single value that can be compared to the total resource value of the coal; and second, by estimating values appropriate to the state within and production region that specify, for the community at-large, the opportunity costs resulting from foregone agricultural outputs as land resources are withdrawn from agriculture and utilized in the production of coal. To make the comparison of the total resource value of coal, it is necessary that the annual agricultural output per acre be converted to a measure of present value. In the course of future analyses, the present value of land used in coal production can be compared to the present value of land in agricultural production. To estimate the present value of land in agriculture, we have estimated the capitalized¹⁵ value of land for each state within the production regions. The capitalized value assumes that the return to farmers as a result of agricultural productive activity is 100 percent of gross returns. This of course, is not true, but by making such an assumption we can estimate the upper bound for the opportunity costs of land in agriculture. Thus, this analytic framework also enables separate estimates of agricultural factor payments and expected values of agricultural opportunity costs. The upper limit of the present value of agricultural opportunity costs of land not including externalities are presented in Table H-91. The application of information on regional earnings in agriculture as a percent of the gross value of agricultural sales reduces the upward bias in the Table H-91 estimates. The resulting value is no longer an upper limit, but, rather, is an estimate of the average agricultural opportunity cost of land.

Regional agricultural earnings used in this analysis are estimated to equal 18 percent of the value of all agricultural products sold for all regions.¹⁶ This is an approximation of the national average and has not been varied among the coal production regions. The loss of these earnings is an additional estimate of agricultural opportunity costs. The generation of information about the level of value-added in agriculture for

each coal production area will allow more specific estimates of agricultural earnings and accordingly, opportunity costs. Once calculated, these revised estimates will reflect the wide differences in the agricultural sectors of the various coal producing areas.

To this point in the analysis, externalities (indirect effects) have not incorporated in the estimation of opportunity costs. The next step in the analysis is to examine the indirect consequences of reducing the agricultural land base within each coal region. Such reductions are external to the agricultural sector and are the result of interdependence in regional economies. It is assumed that surface mining will reduce output by the average capitalized value shown in Table H-76 and that "regional final demand" will be also reduced by this amount. While external decreases in output in the agricultural sector are generated by coal mining, e.g., fewer farms result in reduced demand for tractors, in many instances these decreases may be offset by increased coal industry demand for comparable goods and services. The estimates presented in Table H-92 represent the maximum total direct and indirect change in regional earnings resulting from the use of one acre of land for mining activities. From the estimates presented in Table H-92, it is possible to estimate expected values of total capitalized agriculture opportunity costs including direct and indirect costs within a coal producing region. These estimates are presented in Table H-93.

It must be emphasized that the agricultural opportunity costs presented are estimated for an average acre of land in each coal region regardless of current use and without knowing the precise location of potential mining activities.

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which in this case is taken to be the average value of agricultural output per acre of all land by the interest rate.

¹⁶ Estimated as a simple average of data for Sector 3: meat, animals and miscellaneous livestock products and Sector 5: feed grains, and grass seeds Table C-1 in U.S. Water Resources, Guidelines 5 [35].

¹³ The use of the National input-output table or a regional input-output table might be used to estimate intra-agricultural transactions.

¹⁴ Input-output models could also be used in this case to estimate sales of other sectors to agriculture.

¹⁵ Capitalized value is computed by dividing the yield of an investment

TABLE H-90

VALUE OF ALL AGRICULTURAL PRODUCTS SOLD PER ACRE OF ALL LAND^(a)

Northern Appalachian		Powder River	
Pennsylvania	52.24	Montana	6.43
Ohio	86.28	Wyoming	4.68
West Virginia	8.64	Green River - Hams Fork	
Maryland	97.94	Colorado	4.14
Central Appalachian		Wyoming	2.58
West Virginia	8.64	Idaho	56.31
Virginia	37.70	Utah	7.70
Kentucky	49.33	Fort Union	
Tennessee	35.28	Montana	14.95
Southern Appalachian		North Dakota	26.34
Tennessee	35.28	South Dakota	9.91
Georgia	50.04	San Juan River	
Alabama	34.59	Arizona	1.03
Eastern Interior		New Mexico	1.56
Iowa	176.52	Colorado	7.48
Illinois	130.76	Utah	1.20
Indiana	113.09	Uinta - Southwestern Utah	
Kentucky	49.33	Colorado	4.50
Western Interior		Utah	4.79
Iowa	176.52	Denver - Raton Mesa	
Missouri	52.18	Colorado	69.37
Arkansas	56.57	New Mexico	4.96
Oklahoma	36.23		
Kansas	70.34		
Nebraska	76.26		
Texas-Gulf			
Texas	33.60		
Arkansas	56.57		
Louisiana	41.48		

(a) 1974 dollars.

TABLE H-91

MAXIMUM AGRICULTURAL OPPORTUNITY COSTS OF MINING, SHOWING CAPITALIZED
VALUE OF ALL AGRICULTURAL PRODUCTS SOLD PER ACRE OF ALL LAND (a)

Northern Appalachian		Powder River	
Pennsylvania	522	Montana	64
Ohio	863	Wyoming	47
West Virginia	86		
Maryland	980	Green River - Hams Fork	
		Colorado	41
Central Appalachian		Wyoming	26
West Virginia	86	Idaho	563
Virginia	377	Utah	77
Kentucky	493		
Tennessee	353	Fort Union	
		Montana	150
Southern Appalachian		North Dakota	263
Tennessee	353	South Dakota	99
Georgia	500		
Alabama	346	San Juan River	
		Arizona	10
Eastern Interior		New Mexico	16
Iowa1765	Colorado	75
Illinois1308	Utah	12
Indiana1131		
Kentucky	493	Uinta - Southwestern Utah	
		Colorado	45
Western Interior		Utah	58
Iowa1765		
Missouri	522	Denver - Raton Mesa	
Arkansas	566	Colorado	694
Oklahoma	362	New Mexico	50
Kansas	703		
Nebraska	763		
Texas-Gulf			
Texas	336		
Arkansas	566		
Louisiana	415		

(a) Assumes interest rate of 10% - 1974 dollars.

TABLE H- 92

MAXIMUM DIRECT AND INDIRECT AGRICULTURAL OPPORTUNITY COSTS OF MINING

Northern Appalachian		Powder River	
Pennsylvania	799	Montana	90
Ohio	1338	Wyoming	68
West Virginia	118	Green River - Hams Fork	
Maryland	1499	Colorado	59
Central Appalachian		Wyoming	39
West Virginia	126	Idaho	805
Virginia	535	Utah	116
Kentucky	700	Fort Union	
Tennessee	501	Montana	116
Southern Appalachian		North Dakota	350
Tennessee	505	South Dakota	132
Georgia	715	San Juan River	
Alabama	516	Arizona	15
Eastern Interior		New Mexico	23
Iowa	2524	Colorado	109
Illinois	1831	Utah	117
Indiana	1663	Uinta - Southwestern Utah	
Kentucky	725	Colorado	65
Western Interior		Utah	69
Iowa	2524	Denver - Raton Mesa	
Missouri	809	Colorado	1055
Arkansas	855	New Mexico	72
Oklahoma	547		
Kansas	1090		
Nebraska	1068		
Texas-Gulf			
Texas	501		
Arkansas	798		
Louisiana	606		

*Present sum of the capitalized value of all agricultural products sold per acre of all land from Table H-91 and the indirect component; regional earnings dependent upon agricultural output per acre of all land.

**1974 dollars.

TABLE H-93

ESTIMATED AGRICULTURAL OPPORTUNITY COSTS OF MINING

Northern Appalachian		Powder River	
Pennsylvania	144	Montana	17
Ohio	240	Wyoming	12
West Virginia	21	Green River - Hams Fork	
Maryland	269	Colorado	10
Central Appalachian		Wyoming	8
West Virginia	22	Idaho	144
Virginia	97	Utah	21
Kentucky	126	Fort Union	
Tennessee	91	Montana	38
Southern Appalachian		North Dakota	63
Tennessee	92	South Dakota	24
Georgia	129	San Juan River	
Alabama	92	Arizona	3
Eastern Interior		New Mexico	4
Iowa	455	Colorado	20
Illinois	329	Utah	3
Indiana	300	Uinta - Southwestern Utah	
Kentucky	131	Colorado	12
Western Interior		Utah	13
Iowa	455	Denver - Raton Mesa	
Missouri	146	Colorado	190
Arkansas	154	New Mexico	13
Oklahoma	98	Texas-Gulf	
Kansas	197	Texas	89
Nebraska	192	Arkansas	143
Texas-Gulf		Louisiana	110

* Includes capitalized values of regional agricultural earnings (direct plus indirect) per acre of all land.

**1974 dollars.

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APPENDIX I

RECLAMATION COST

1870-1872

1870-1872

APPENDIX I

RECLAMATION COST

I.1 OVERVIEW

This appendix provides an overview of mined-land reclamation costs. The analysis should be viewed in conjunction with the discussion in section 5.2.2.1 concerning land disturbance projected under the various Federal coal management alternatives.

The direct costs of planning, backfilling, and revegetation plus agricultural production losses during the reclamation period equal total reclamation costs. For the following discussion, it is assumed that the post-mining and pre-mining dominant land use is the same. In addition, only surface-mined land is considered since underground mining disturbs relatively small amounts of surface area and reclamation costs per ton of coal mined are very small (2-5¢/ton in the Uinta-Southwestern Utah region or less than 0.3 percent of the 1975 F.O.B. mine price of coal [1,2].

Direct reclamation costs, agricultural production losses, and total reclamation costs for each western region are presented in Table I-1. Note that costs attributed to agricultural production losses do not change the relative order of regional total costs.

The percent of the F.O.B. mine price of coal which would be attributable to total reclamation costs is estimated to be:

	Total Reclamation Cost (\$/ton)	Percent of 1976 F.O.B.-mine Price of Coal [3]
Powder River	0.0513	0.7
San Juan River	0.0869	0.7
Green River		
Hams Fork	0.1156	1.0
Fort Union	0.2531	5.0
Denver-Raton Mesa	0.4174	no data

Direct reclamation costs for the reclamation of cropland in the Western Interior and Eastern Interior Coal Regions are estimated to average \$2.59/ton and \$2.75/ton of coal mined, respectively [4,5,6]. The average annual production (market) value of cropland is estimated to be [7]:

	Weighted Averages	
	\$/acre/yr.	\$/ton of coal mined
Western Interior	128	0.024
Eastern Interior	209	0.020

The above weighted averages are based on production values of major crops, total acres harvested per crop type in each component state, and component state percentages of

total regional surface area. Assuming prime cropland can be reclaimed in 5 to 15 years, minimum and maximum total reclamation costs would be: as presented in Table I-2.

Pastureland and marginal cropland could be reclaimed 60 percent quicker than prime cropland (or 3 years) and direct reclamation costs would be 71 percent and 51 percent lower, respectively [8,9,10]. Total estimated reclamation costs therefore, would be:

	\$/Ton of Coal Mined	
	Rangeland	Marginal Cropland
Western Interior	0.82	1.34
Eastern Interior	0.86	1.41

The percent of the F.O.B. mine price of coal for each of these land uses attributable to total reclamation costs is estimated to be [2]:

	Western Interior	Eastern Interior
Prime Cropland	19.1-20.8%	24.6-26.3%
Marginal Cropland	9.4%	12.2%
Rangeland	5.8%	7.4%

Higher percentages in the Eastern Interior Coal Region are attributed to higher total reclamation costs and a lower F.O.B.-mine coal price than in the Western Interior Coal Region.

Grazing land in the Texas Coal Region is commonly restored in 1 year [11] and direct reclamation costs average \$0.15/ton of coal mined [12]. Annual production (market) value of rangeland is estimated to be \$2.15/acre or \$0.00018/ton of coal mined [7]. Total reclamation costs, therefore, are \$0.15918/ton of coal mined. The percent of F.O.B.-mine coal price attributed to reclamation costs cannot be calculated due to the withholding of data to avoid disclosing confidential company data [2].

Dominant land use in the Northern, Central and Southern Appalachian regions is forest. Before mining, timber is clearcut and sold. Since production losses following mining are compensated by the sale of timber before mining, timber production losses during the reclamation time period would be negligible [14,15]. This assumes that cleared stands are of sufficient age (i.e., greater than 15 years) to be of economic value and that post-mining productivities are equal to pre-mining values. Professional forest management would be required to assure the latter. Whether the costs associated with forest management can be compensated by the silviculture of species more valuable than pre-mining species, or by the attainment of higher productivities after reclamation, is

TABLE I-1

TOTAL RECLAMATION COSTS
(Western Regions)

<u>DIRECT COSTS^a</u>					
<u>COAL REGIONS</u>	<u>EARTHWORKS</u>	<u>REVEGE- TATION</u>	<u>OVER- HEAD</u>	<u>TOTAL \$/ACRE</u>	<u>TOTAL \$/ACRE</u>
Fort Union	\$3,758	\$158	\$319	\$4,235	\$0.25
Powder River	3,802	140	385	4,377	0.05
Green River-Hams Fork ^b	2,018	213	424	2,639	0.11
Uinta-Southwestern Utah ^b	-	-	-	-	-
Denver-Raton Mesa ^b	1,878	303	606	2,780	0.40
San Juan River	1,739	393	788	2,900	0.08

<u>PRODUCTION LOSS^c</u>			
	<u>YEARS TO RECLAIM</u>	<u>PRODUCTION \$/TON/YEAR</u>	<u>PRODUCTION LOSS \$/TON/YEAR</u>
Fort Union	8.0	3.9×10^4	0.0031
Powder River	9.6	1.4×10^{-4}	0.0013
Green River-Hams Fork ^b	10.0	5.6×10^{-4}	0.0056
Uinta-Southwestern Utah ^b	-	-	-
Denver-Raton Mesa	13.4	1.3×10^3	0.0174
San Juan River	14.1	4.9×10^{-4}	0.0069

<u>TOTAL RECLAMATION COSTS</u>			
	<u>DIRECT (\$/TON)</u>	<u>PRODUCTION LOSS (\$/TON)</u>	<u>TOTAL COST (\$/TON)</u>
Fort Union	0.25	0.0031	0.2531
Powder River	0.05	0.0013	0.0513
Green River-Hams Fork ^b	0.11	0.0056	0.1156
Uinta-Southwestern Utah ^b	-	-	-
Denver-Raton Mesa	0.40	0.0174	0.4174
San Juan River	0.08	0.0069	0.0869

^aSource: Reference Number 3.^bThe Uinta-Southwestern Utah region is not listed since surface mining through 1995 will be negligible. Since no data were presented to Leathers for the Denver-Raton Region, the per acre values of the Green River-Hams Fork and San Juan River Regions were averaged and then converted to \$/ton values for this region using an average ton/acre value of 7,000.^cFor comparative purposes, crop production gains made during the reclamation period are assumed to be zero.

TABLE I-2
MINIMUM AND MAXIMUM TOTAL RECLAMATION COSTS
WESTERN AND INTERIOR REGIONS

Min. & Max. Years to Re- claim Prime Cropland	X	Annual Crop- land Produc- tion Per Ton Coal Mined (\$)	=	Cropland Production Lost for Entire Reclamation Period (\$)	+	Direct Costs Per Ton (\$)	=	Total Reclamation Costs Per Ton of Coal Mined (\$)
<u>Western Interior</u>								
5		0.024		0.12		2.59		2.71
15		0.024		0.36		2.59		2.95
<u>Eastern Interior</u>								
5		0.020		0.10		2.75		2.85
15		0.020		0.30		2.75		3.05

uncertain due to the relative infancy of mined timberland reclamation.

Direct reclamation costs were estimated as a function of the slope of natural terrain and the overburden: coal stripping ratio [16]. For 13 model mines studied, the average cost of reclamation was estimated to be \$5.21/ton of coal mined with a range of \$1.73-\$9.83 per ton. Approximate original contours were restored for each mining method. When mining to a maximum stripping ratio of 20, reclamation which would meet Federal regulations was estimated to be \$1.59, \$3.27 and \$5.51/ton of coal mined on 15°, 20° and 25° terrain, respectively. The cost of providing full reclamation at a stripping ratio of 30 was estimated to be \$2.09, \$4.13, and \$7.26/ton of coal mined on 15°, 20° and 25° terrain, respectively.

The percent of the total F.O.B.-mine price of coal attributed to reclamation costs is estimated to be [2]:

Terrain Angle	Stripping Ratio	Appalachian Region		
		Northern	Central	Southern
15°	20	8.0	7.8	7.7
20°	20	16.4	15.8	15.9
25°	20	27.7	26.6	26.8
15°	30	10.5	10.1	10.2
20°	30	20.8	20.0	20.1
25°	30	36.5	35.1	35.3

Total reclamation costs (\$/ton) and percentage of F.O.B.-mine price of coal for each region are summarized in Table I-3.

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TABLE I-3

TOTAL RECLAMATION COSTS (%/TON) AND PERCENTAGES OF
F.O.B.-MINE PRICE OF COAL FOR EACH COAL REGION

COAL REGION	TOTAL RECLAMATION COSTS (\$/TON)	PERCENT OF F.O.B. MINE-PRICE OF COAL (1975) ^a
Northern Appalachian	1.73	2.0
Central Appalachian	1.73	7.8
Southern Appalachian	1.73	7.7
Eastern Interior	0.86	7.4
Western Interior	0.82	5.8
Texas	0.15	No Data
Powder River	0.05	0.7
Green River-Hams Fork	0.12	1.0
Fort Union	0.25	5.0
San Juan River	0.09	0.7
Uinta-Southerwestern Utah	No Data	No Data
Denver-Raton Mesa	0.42	No Data

^aSources: Reference Numbers 2 and 3.

